MODEL T200UP NITROGEN DIOXIDE (NO-NO_2-NO_x) MONITORING SYSTEM – 500 PPB

Section II

OPERATOR RESPONSIBILITIES

Revision 1.1

November 15, 2016

Approval Sign Off-Sheet

I certify that I have read and approve of the contents of the Model T200UP Nitrogen Dioxide (NO-NO_2-NO_x) Monitoring System – 500 PPB, Section II, Operator Standard Operating Procedure with an effective date of December 01, 2016.

Regional Office Representative
Rik Tebeau, Regional Coordinator/Lead

Signature: R Tebeau Date: 11/14/2016

Central Office Lead
Kay Roberts, Environmental Chemist

Signature: K. Roberts Date: 17 · Nov. 2016

Electronics and Calibrations Branch Lead
Mark Yirka, Electronics Tech III

Signature: Mark Yirka Date: 11/16/2016

Projects and Procedures Branch Supervisor
Joette Steger

Signature: Joette Steger Date: 11/16/2016

Ambient Monitoring Section Chief
Joette Steger, Rotating Section Chief

Signature: Joette Steger Date: 11/16/2016

US Environmental Protection Agency
Laura Ackerman, Region 4 SESD

Signature: _____ Date: _____

Table of Contents

2.17.2.1 General Background Information and Initial Site Checks

On February 9, 2010, the U.S. Environmental Protection Agency (EPA) finalized new minimum monitoring requirements for the nitrogen dioxide (NO2) monitoring network in support of a 1-hour NO2 National Ambient Air Quality Standard (NAAQS). In the new monitoring requirements, state and local air monitoring agencies are required to install near-road NO2 monitoring stations at locations where peak hourly NO2 concentrations are expected to occur within the near-road environment in large urban areas.

In support of the new monitoring requirements, the State of North Carolina operates NO-NO2-NOX monitors across the state for the purpose of monitoring the ambient NO-NO2-NOX exposure of the general population. In order to collect accurate, meaningful data the monitors must be operated in a consistent manner. The goal of this document is to establish a continuous, verifiable and defensible set of procedures and a means to record events and activities with regard to the site and the instrument as required by the United States Environmental Protection Agency (US EPA), 40-CFR 50, 53, and 58.

All original records (electronic logbook, site logbook, etc.) must be legible, compete, dated and signed or initialed by the operator and retained as a part of the permanent analyzer record. The operator's name and/or initials presented on the elog will certify that the activities indicated have been performed in accordance with this Standard Operating Procedure (SOP) and that the information contained on the form is accurate (reference NC DAQ Quality Assurance Project Plan [QAPP] Revision 2.1 for examples of elog and forms). All records will be reviewed and verified by the Regional Chemist and audited by the responsible chemist at the North Carolina Division of Air Quality (DAQ).

2.17.2.1.1 Monitoring Instrumentation, Equipment and Accessories

- Teledyne Model T200UP NO-NO2-NOXAnalyzer
- Teledyne Model T700 Gas Calibrator
- Teledyne Model 701 Zero Air Generator
- Certified "NO" Gas Cylinder
- Data Acquisition Software (DAS) (e.g. AV-Trend), Site PC, Ethernet

In general, the T200UP NO-NO2-NOX analyzer system consists of the following components:

- Pneumatic System: This portion of the analyzer consists of a sample inlet incorporating a heated converter, sample inlet line, particulate matter filter, gas phase titration calibration unit, ozone generator, pre-reactor, and pump, all used to bring ambient air samples to the analyzer inlet.
- Analytical System: This portion of the analyzer consists of the reaction chamber, photomultiplier, and bandpass filters.
- Electronic Hardware: This portion of the analyzer consist of the electronic components that control the analyzer and process the signals.

Calibration of the photolytic analyzer consists of a three-step process:

1. Calibrate the ZERO using dry instrument grade air
2. Calibrate the Nitric Oxide (NO) and the Oxides of Nitrogen (NOX) slopes using instrument grade NO calibration gas balanced with nitrogen.
3. Calibrate the NO2 by gas phase titration (GPT) through two converter efficiency points: CEB 80-90% Full Scale and CEA: 10-20% Full Scale, in the order given.

2.17.2.1.2 Continuous Monitoring Principles Applicable to the NO-NO2-NOX Monitoring System

- Calibration: A calibration is required
  - During the site start-up and upon closure of the site
  - Whenever the system's operation is interrupted for more than 48 hours without power or offline (such as in the case of shelter repairs or hurricanes) or major repairs/maintenance.
  - When the SPAN drift on the nightly auto-calibration check or calibration check (on site or remote) NO/NOX is ±8% (SPAN 1), and ±8% (SPAN 3) or when the zero drift on the nightly auto-calibration or calibration check (on site or remote) is greater than or equal to ±1 PPB. Replace the particulate filter and perform calibration.
  - ***A full calibration (including titrations) is required every 365 days, regardless of instrument and site performance.***
  - No calibrations or calibration check, should be completed between 6:00 AM and 9:00 AM local time when the potential for ambient exceedances exist.

- Calibration Check: A calibration check is required once every 14 days or less - as part of a calibration check, perform two (2) titration checks (40 CFR 58 Appendix A Section 3.2.1).
- The particulate filter should be changed and a leak check performed.
- The shelter temperature sensor must be compared to a NIST traceable thermometer.
- Verification of instruments, calibration gas cylinder number and certification date should be completed during each calibration or calibration check. Contact Electronics and Calibration Lab (ECB) when the calibration cylinder pressure reaches 500 psig. The calibration cylinder must be replaced before it reaches 200 psig. Note actions taken in the electronic logbook.
- At each visit, the site should be inspected for general maintenance issues such as condition of shelter and sample lines. Clock times of the components at the site are to be verified, and if necessary corrected, during each site visit.
- No calibrations or calibration check, should be completed between 6:00 AM and 9:00 AM local time at the near road site and area-wide site or when the potential for ambient exceedances exist.

2.17.2.1.3 Site Visit and Checks

Upon arrival at the site, observe the outside of the shelter and probe inlet, looking for vandalism or security breaches. Verify that the probe inlet and screen are in place and that the sample line is not blocked by insects or other debris. *Document all observations and actions in the elog, Logbook Tab.* If there is evidence of vandalism the operator should contact the appropriate law enforcement department (generally this is the city police department if the monitor is within city limits or the county's sheriff's department if outside city limits) as well as the Regional Chemist, the Central Office (CO), and the ECB of DAQ. Check the DAS for appropriate date/time and concentration readings. The Regional Chemist and a member of the Projects and Procedures Branch (PPB) should review the data generated during any "out-of-control" period to determine if the data should be flagged or invalidated.

A. Shelter Temperature

Measure and record the internal temperature of the building in ^{o}C using a NIST traceable thermometer placed next to the shelter temperature sensor. If the NIST traceable thermometer was brought to the site, allow sufficient time for the reading to stabilize. Compare the two temperature readings, *record values in the elog Logbook Tab.* If the shelter temperature sensor is reading greater than ± 2 ^{o}C of the reference, contact the ECB. Adjust the site thermostat as necessary to maintain the shelter temperature within 20 ^{o}C to 30 ^{o}C range. If the

temperature cannot be stabilized and controlled within this range, notify the Regional Chemist and the ECB that corrective action is required. *Document in the elog, Logbook Tab.*

Note: The shelter temperature should remain fairly constant and not vary more than ± 2 °C standard deviation over any 24-hour period. The statistician at the CO keeps track of this statistic. The Regional Chemist will be notified if an issue arises.

B. Electrical Power and Sample Line Check

Observe the analyzer, calibrator, computer and data logger for indications of a power failure, and if needed, correct the cause. If the analyzer or calibrator lost power, allow an equilibration period of at least 60 minutes for the instrument to stabilize after being powered up. Visually inspect the sample line tubing, especially at any bends, to ensure that it has not kinked, crimped, cut, or to ensure that insects have not nested in the lines. Particulate matter and/or moisture may also collect in the sample line leading to the instrument. Ensure that the sample line is being heated and slightly warm to the touch. The ECB is required to replace the sample line every two years, and will perform a sample line integrity check at their yearly audit (Reference Section I (SOP 2.17.1): ECB Responsibilities for details). *Record all events in the elog, Logbook Tab.*

C. Data Logger Time and Date Check

The times for the data logger, AV-Trend, and computer must be EASTERN STANDARD TIME and be synchronized to the NIST time provider in Colorado (±1 minute). *Record the computer, data logger, and NIST time on the elog created for a site visit Logbook Tab.*

1. Click on the date and time in the lower right corner of the computer screen
2. Select **Change Date and Time** settings
3. Select the **Internet Time** tab, and then press the **Change Settings** button
4. Check the box that states **Synchronize with an Internet Server**. From the server drop down menu, select time.nist.gov
5. Press **Update Now**
6. Confirm that the task is enabled
7. Select OK to exit. The created task scheduler named **"Clock Sync"** in AV-Trend will sync the data logger and computer times

If the data logger time is not within 1 minute of NIST time but it matches the computer time, then there is a problem with the computer time. Either the computer is not synchronizing properly with the NIST time or the clock is drifting too much and needs to be synchronized more often or the computer needs to be replaced. Call the ECB lab and they will help identify the issue and tell you what to do to correct it.

Sources for getting the correct time:

- Call the ECB lab and ask for the NIST time
- Call the NIST Colorado time at (303) 499-7111
- Correct time loaded into cell phone
- Correct time website, http://nist.time.gov

D. Model 701 Zero Air Generator Check

Verify that the delivery pressure is set to 30 ± 2 psig. If the delivery pressure is outside of the ± 2 psi range, adjust the pressure using the pressure adjust control knob. *Document in the elog, Logbook Tab.* As the expiration date of the Model 701 Zero Air Generator approaches, contact the ECB to make arrangements for new materials.

E. Calibration Gas Cylinder and Calibrator Check

Verify that the calibration gas cylinder and/or calibrator are in certification and *document certification dates in the elog, Logbook Tab.* Calibration gas cylinders at a concentration of approximately 10.0 ppm are certified for four years from the original date of the manufacturer's certification. If the calibration gas cylinder pressure **is less than 500 psig,** the ECB should be notified and a new cylinder is required. The delivery of a new calibration gas cylinder or calibrator must be coordinated with the Region.

Calibrator certification is valid for *twelve months* and the calibration and/or expiration date(s) should be indicated on a label located on the front panel of the instrument.

Verify that the calibrator has the correct cylinder concentration stored in memory. Cylinder concentration can be accessed from the instrument panel through the following steps (Reference Section 2.17.2.1.5 Figure 2):

1. Make sure the calibrator is in the "STANDBY" mode (if not, press "STBY")
2. Press the following key in the order given: "SETUP" "GAS" "CYL" "PRT1"
3. Verify the concentration entered corresponds to the calibration cylinder = "~10.0 PPM NO"
4. Press "EXIT" "EXIT" "EXIT" "EXIT" (until "STANDBY" mode is reached)

F. Particulate Filter

The particulate filter must be ***replaced at a minimum of every 14 days.*** It is recommended that when the filter is changed; handle the filter and the wetted surface of the filter housing as little as possible. Teledyne API recommends using gloves or tweezers to avoid contamination of the sample filter assembly. **See Appendix C: Filter Change and Leak Check Procedure**, for detailed instruction on changing the particulate filter and performing a leak check. *Record filter change and leak check pass/fail (Y/N) in the elog, Logbook Tab.*

2.17.2.1.4 Teledyne Model T200UP NO-NO2-NOX Analyzer Operational Check

Verify and record *(elog, Logbook Tab)* the T200UP instrument settings using the "<TST or TST>" buttons on the front of the instrument panel (Figure 1). Instrument setting should be:

Parameter	Expected Value
Instrument Range/Concentration Units	500 PPB
RCELL Temp	40 ± 0.1 °C
Box Temp	Amb ± 5 °C
PMT Temp	5 ± 2 °C
RCELL (Pressure)	< 4.0 in Hg-A
SAMP (Pressure)	Amb ± 1.0 in Hg-A
Alarm? (Y/N)	

A value of "XXXX" displayed for any of the functions indicates an out-of-range reading or the analyzer's inability to calculate the reading.

Figure 1: T-200UP Main Menu Screen

1 = Concentration
2 = Instrument Mode
3 = Parameter
4 = Touch Control Buttons

2.17.2.1.5 T700U Dynamic Gas Calibrator Operational Check

The most common and/or serious instrument failures will result in a warning message being displayed on the front panel of the instrument. The T700U will alert the user that a Warning Message is active by flashing the "FAULT" LED, and displaying the warning message in the parameter field. The "MSG" button displays if there is more than one warning in the queue or if the instrument is placed in the "TEST" menu and messages have not been cleared.

To view or clear the various warning messages (Figure 2):

- Verify the calibrator is in the "STANDBY" mode, if not press "STBY"
- Press "TEST" to view warning message in the parameter field
- Press "CLR" to clear the warning

Note: If the T700U reads "REGULATOR PRES WARN" after the ZERO/SPAN is generated, verify the "CAL PRESS" and "DIL PRESS" are 25-30 psig while performing SPAN 1 by scrolling through the "<TST or TST>" buttons.

Figure 2: T700U Main Menu Screen

1 = Concentration
2 = Instrument Mode
3 = Parameter/Warning Message
4 = Touch Control Buttons

2.17.2.2 Detailed Procedures

2.17.2.2.1 Manual Calibration

See Section 2.17.2.1.2 for Manual Calibration requirements. Preform the following Pre-Calibration procedures before calibrating the Model T200UP.

1. Using AV-Trend Software Disable the NOXCAL channel on the Data Logger
    - Press <ESC> <ESC> to return to Home Menu
    - Select "C" (Configuration Menu) <Enter>
    - Select "D" (Configure Data Channels) <Enter>
    - Select "M" (Disable/Mark Channel Offline) <Enter>
    - Arrow down to Select "NO"
    - Repeat for "NO2" and "NOX" <Enter>
    - Press <ESC> twice to return to home menu
2. To view the minute data on the data logger:
    - Select "D" (Display Real-Time) <Enter>
    - Select "C" (Continuous Average Report) <Enter>
    - Select "Show Channels 3" <Enter>
    - Type in parameters "NO", "NO2", and "NOX" ("TMP" is optional) <Enter>
    - Press <ESC> twice to return to home menu
3. Using the T200UP display screen, press "<TST or TST>" to display and record *(elog, Logbook Tab, Pre-Cal)* the following:

Function	Minimum Value	Optimum Value	Maximum Value
NOX Slope	-0.700	1.000	1.300
NOX OFFS	-20.0 mV	0.0 mV	150.0 mV
NO Slope	-0.700	1.000	1.300
NO OFFS	-20.0mV	0.0 mV	150.0 mV

4. Record *(elog, Logbook Tab, Pre-Cal)* "SETA" gain and "SETB" gain prior to calibration
5. Reset Convertor Efficiency A and B:
    - Press "CALS"
    - Press "CONC"
    - Press "CONV"
    - Press "SetA"
    - Toggle the left most buttons until the "Param" field displays **1.000**, then press <ENTR>
    - Press "SETB"
    - Toggle the left most buttons until the "Param" field reads **1.000**, then press <ENTR>
    - Press <EXIT> <EXIT> <EXIT> to leave the Converter Efficiency menu.
6. Change the Particulate Filter and perform a leak check. See Section 2.17.2.2.4 for instructions and/or **Appendix C: Filter Change and Leak Check Procedure** for detailed instructions and diagrams.
7. If desired, a graph of the minute data during a calibration can be created to track the stabilization of each value. Instructions on how to graph the minute data in AV-Trend are located in **Appendix D: Real Time Minute Data Graphing in AV-Trend**.

A. SPAN ZERO Calibration
   A. On the site computer using the data logger in AV-Trend:
      - From the home menu initiate SPAN ZERO using "C", "C", "1" command
      - Select "NOXCAL" <Enter>
      - Select "SPAN ZERO" <Enter>
      - Select "Phase Duration" (Set to 4h) <Enter>
      - Select "Start Single Cal (Now)" <Enter>
      - Press <ESC> twice to return to home menu
   B. To view the minute data on the data logger:
      - Select "D" (Real Time Display Menu) <Enter>
      - Select "C" (Continuous Average Report) <Enter>
      - Select "Show Channels 3" <Enter>
      - Type in parameters "NO, NO2, NOX" ("TMP" is optional) <Enter>
      - Start Continuous Report (Minute averages will be displayed on screen)
   C. The T200UP Panel will indicate ZERO CAL R
      - Toggle the "<TST or TST> button to display the NOX STB test function

NOTE: The NOX STB is the standard deviation of concentration readings of the selected gas. Data points are recorded every ten seconds. The calculation uses the last 25 data points.

- Press "ZERO" allow additional time for the instrument to stabilize, until NOX STB < 0.100 ppb, ~15 min.
- Record "DIL Pressure" *(elog, Logbook Tab)* during SPAN ZERO
- Press "ENTR" to change the Offset/Slope, based on the zero-point measurement
- Allow instrument to stabilize until NOX STB < 0.100 ppb, ~10 min.
- Record actual "DIL Flow", and five stable 1-minute "NO", "NO2" and "NOX" averages *(elog, Calibration Tab, ZERO).* **NOTE: The measured zero must be ± 1 ppb.**

   D. Using the data logger in AV-Trend, abort SPAN ZERO:
      - Press <ESC> as needed to return to main menu
      - Abort SPAN ZERO, using "C", "C", "W"
      - "NOXCAL" <Enter>

B. SPAN 1 Calibration

Adjust the NO flow from the standard NO cylinder to generate a NO concentration of about 80% of the upper range limit (URL) of the NO range.

The exact NO concentration is calculated from:

$$[NO]_{ca} = [F_{NO}/(F_{NO} + F_{zero})] * [NO_{std}]$$
$$[NO_2]_{ca} = [F_{NO}/(F_{NO} + F_{zero})] *[NO_{std}]$$

Where: $FN_O + F_{zero}$ = pre-programmed air and gas flows in SCCM
$[NO_{std}]$ = Certified NO gas concentration

Convert: Liters to SCCM by multiplying LPM * 1000
PPB to PPM by multiplying * 1000

   A. From the Home Menu on the site computer using the data logger in AV-Trend:

- Initiate SPAN1 using "C", "C", "1" command
- Select "NOXCAL" <Enter>
- Select "SPAN 1" <Enter>
- Select "Phase Duration" (Set to 8h) <Enter>
- Select "Start Single Cal (Now)" <Enter>
- Press <ESC> twice to return to home menu

B. View the minute data on the data logger:
- Select "D" (Display Real-Time) <Enter>
- Select "C" (Continuous Average Report) <Enter>
- Select "Show Channels 3" <Enter>
- Type in parameters "NO", "NO2", and "NOX" ("TMP" is optional) <Enter>

C. On the T200UP Panel
- Allow instrument to stabilize until NOX STB < 0.100 ppb, ~15-20 min.
- Press "CONC"
- Press "NOX" – using the left most buttons, *Set* the "NOX" CAL gas concentration = 425, Press <ENTR>
- Press "NO" – using the left most buttons, *Set* the "NO" CAL gas concentration = 425, Press <ENTR> if "SPAN" is available press <ENTR> otherwise press <EXIT> for SPAN
- Press "SPAN", <ENTR> – allow instrument to stabilize until NOX STB < 0.100 ppb, ~20-30 min
- Record actual "CAL Pressure", "CAL Flow", "DIL Flow", and five stable 1-minute "NO", "NO2" and "NOX" averages *(elog, Calibration Tab, SPAN 1).* **NOTE: The measured "NO" and "NOX" span should be ± 3% of the expected value.**

C. Titration/Calibration

The following procedure uses gas phase titration to calibrate the NO2 channel. The two points should be located at the 80-90% (B-CAL) of full scale and 10-20% (A-CAL) of full scale in the order given.

A. GPTZ 80-90% Full Scale - On the T700U Panel
- Press "GEN"
- Press "GPTZ" – Using the "<TST or TST>" button, *Set* the "NO" cal concentration = 425 ppb, Press <ENTR>
- Using the "<TST or TST>" button, *Set* the "O3" concentration = 405 ppb Press <ENTR>
- Using the "<TST or TST>" button, *Set* the "TOTAL FLOW" = 3.000 LPM Press <ENTR>
- Display and Record "NO", "O3", "TOTAL FLOW" values entered. *(elog, Calibration GPT Tab, GTPZ settings entered)*.
- Allow instrument to stabilize until NOX STB < 0.200 ppb, ~20-30 min.
- Record actual "NO", "CAL Flow", "DIL FLOW", and five stable 1-minute "NO", "NO2" and "NOX" averages *(elog, Calibration GPT Tab, 80-90% FS GPTZ Titration "CalB" as well as GTPZ settings entered and T700U Display GPTZ values)*.

B. GPTPS 80-90% Full Scale - On the T700U Panel
- Press "GEN"
- Press "GPTPS" – Using the "<TST or TST>" button, *Check:* "NO" concentration = 425 ppb, "O3" concentration = 405 ppb, and "TOTAL FLOW" = 3.000 LPM, Press <ENTR> for each.

- Keep the T700U in GPTPS mode until the "ACT" value for O3 is within 1 ppb of the target value entered (Active LED not flashing + 5 minutes, ~10 min)

C. GPT 80-90% Full Scale - On the T700U Panel
   - Press "GEN"
   - Press "GPT" - Using the "<TST or TST>" button, *Check:* "NO" concentration = 425 ppb, "O3" concentration = 405 ppb, and "TOTAL FLOW" = 3.000 LPM, Press <ENTR> for each. (Note: There will be no value displayed for O3 during this time)
   - Allow instrument to stabilize until NOX STB < 0.200 ppb, ~20-30 min.
   - Record five stable 1-minute "NO", "NO2", "NOX" averages *(elog, Calibration GPT Tab, 80-90% FS GPTPS/GPT "CALB")*.

D. GPT 80-90% Full Scale NO2 Calibration- On the T200UP Panel
   - Press "CONC"
   - Press "CONV"
   - Press "NO2B" – using the left most buttons, edit and enter the "NO2B (O3)" concentration which is calculated and can be found in *elog,* ***Calibration GPT Tab, Cell J20*** once entered press <ENTR>
   - Press "CALB" – to calibrate the "B" point
   - Press "CAL" <ENTR>, <EXIT>, <SETB>
   - Record the "SETB Gain" Converter Efficiency value on the front panel display *(elog, Calibration GPT Tab, After Adj. Converter Efficiency Box)*.
   - Press <EXIT>, <EXIT>, <EXIT> to leave the converter efficiency menu

E. GPTZ 10-20% Full Scale - On the T700U Panel
   - Press "GEN"
   - Press "GPTZ" – Using the "<TST or TST>" button, *Set* the "NO" concentration = 70 ppb, Press <ENTR>
   - Using the "<TST or TST>" button, set the "O3" concentration = 50 ppb Press <ENTR>
   - Using the "<TST or TST>" button, set the "TOTAL FLOW" = 7.000 LPM Press <ENTR>
   - Display and Record "NO", "O3", "TOTAL FLOW" values entered, *(elog, Calibration GPT Tab, GPTZ Settings)*.
   - Allow instrument to stabilize until NOX STB < 0.100 ppb, ~20-30 min.
   - Record actual "NO", "CAL Flow", "DIL FLOW", "Actual DIL Flow" and five stable 1-minute "NO", "NO2" and "NOX" averages *(elog, Calibration GPT Tab, 10-20% FS GPTZ Titration "CALA" as well as GPTZ settings entered and T700U Display GPTZ values)*.

F. GPTPS 10-20% Full Scale - On the T700U Panel
   - Press "GEN"
   - Press "GPTPS" – Using the "<TST or TST>" button, *Check:* "NO" concentration = 70 ppb, "O3" concentration = 50 ppb, and "TOTAL FLOW" = 7.000 LPM, Press <ENTR> for each.
   - Keep the T700U in GPTPS mode until the "ACT" value for O3 is within 1 ppb of the target value entered (Active LED not flashing + 5 minutes, ~10 min)

G. GPT 10-20% Full Scale - On the T700U Panel
   - Press "GEN"
   - Press "GPT" - Using the "<TST or TST>" button, *Check:* "NO" concentration = 70 ppb, "O3" concentration = 50 ppb, and "TOTAL FLOW" = 7.000 LPM, Press <ENTR> for each. (Note: There will be no value displayed for O3 during this time)

- Allow instrument to stabilize until NOX STB < 0.100 ppb ~15-20 min. Record five stable 1-minute "NO", "NO2", "NOX" averages *(elog, Calibration GPT Tab, 10-20% FS GPTPS/GPT "CALA")*.

H. 10-20% Full Scale NO2 Calibration - On the T200UP Panel
- Press "CONC"
- Press "CONV"
- Press "NO2A" – using the left most buttons, edit and enter the "NO2A (O3)" concentration which is calculated and can be found in *elog,* ***Calibration GPT Tab, Cell J36***
- Press <ENTR>
- Press "CALA" – to calibrate the "A" point
- Press "CAL" <ENTR>, <EXIT>, <SETA>
- Record the "SETA Gain" Converter Efficiency value on the front panel display *(elog, Calibration GPT Tab)*.
- Press <EXIT>, <EXIT>, <EXIT> to leave the converter efficiency menu
- Allow instrument to stabilize until NOX STB < 0.100 ppb, ~15-20 min.
- Record five stable 1-minute "NO", "NO2", "NOX" averages *(elog, Calibration GPT Tab, 10-20% FS Calibration "CALA")*.

I. GPTPS 80-90% Full Scale Check – On the T700U Panel
- Press "GEN"
- Press "GPTPS" – Using the "<TST or TST>" button, *Set* the "NO" concentration = 425 ppb <ENTR>,
- Using the "<TST or TST>" button, *Set* the "O3" concentration = 405 ppb <ENTR>
- Using the "<TST or TST>" button, *Set* the "TOTAL FLOW" = 3.000 LPM <ENTR> (Note: There will be no value displayed for O3 during this time)
- Keep the T700U in GPTPS mode until the "ACT" value for O3 is within 1 ppb of the target value entered (Active LED not flashing ± 5 minutes, ~10 min)

J. GPT 80-90% Full Scale - On the T700U Panel
- Press "GEN"
- Press "GPT" – Using the "<TST or TST>" button, *Check:* "NO" concentration = 425 ppb, "O3" concentration = 405 ppb, and "TOTAL FLOW" = 3.000 LPM, press <ENTR> for each.
- Allow instrument to stabilize until NOX STB < 0.200 ppb, ~20-30 min.
- Record five stable 1-minute "NO", "NO2", "NOX" averages *(elog, Calibration GPT Tab, 80-90% FS Calibration "CALB")*. **These values will be used during each future 14-day 80-90% Full Scale Calibration Check until a new calibration is completed.** *(elog, 14 Day GPT Check Tab)*

D. Purge Procedure

The T700U calibrator's PURGE feature clears residual source gases and calibration mixtures gases from the previous generated steps from the instrument's internal pneumatics as well as any external pneumatic lines downstream from the calibrator. When activated, the PURGE:
- Opens the diluent (zero air) inlet valve allowing zero air to flow into the calibrator from its external, pressurized source.
- Adjusts the diluent air mass flow controller (MFC1) to maximum flow

- Adjusts all component gas mass flow controllers installed in the calibrator to maximum flows (e.g. 10 SLPM and 20 SLPM) to flush out the pneumatic system of the T700U.

To activate the PURGE feature – On the T700U Panel

1. Press "GEN"
2. Press "PURGE"

The calibrator should be purged until the NOX STB on the T200UP panel <0.100 ppb, ~10 min

When the purge is complete: Abort SPAN 1

- Abort SPAN 1, using "C", "C", "W" command
- NOXCAL <Enter>

E. Check SPAN 3 – make no adjustments

- From the home menu Initiate SPAN 3 using "C", "C", "1" command
- Select "NOXCAL" <Enter>
- Select "SPAN 3" <Enter>
- Select "Phase Duration" (Set to 4h) <Enter>
- Select "Start Single Cal (Now)" <Enter>

View the minute data

- Select "D" (Display Real-Time) <Enter>
- Select "C" (Continuous Average Report) <Enter>
- Select "Show Channels 3" <Enter>
- Type in parameters "NO", "NO2", and "NOX" ("TMP" is optional) <Enter>
- Allow instrument to stabilize until NOX STB < 0.100 ppb, ~10 min.
- Record actual "CAL Flow", "DIL FLOW", and five stable 1-minute "NO", "NO2" and "NOX" averages *(elog, Calibration Tab, SPAN 3)*. **NOTE: The measured "NO" and "NOX" span should be ± 5% of the expected value.**
- Press <ESC> twice to return to home menu
- Abort SPAN 3, suing "C", "C", "W" command
- NOXCAL <Enter>

F. Record Post Calibration values *(elog, Logbook Tab)*:

NOX Slope and NOX Offset
NO Slope and NO Offset

NOTE: If the NOX and/or NO Slope or Offset values are outside of the acceptable limits and all other more obvious causes for this problem have been eliminated, a sensor module hardware calibration may be necessary. Reference SOP 2.17.1 Revision 1.1 Section 2.17.1.9 NO-NO2-NOX Monitoring System Maintenance for additional details.

G. Review Calibration and End

- Percent Tolerance Across all Full Scale(FS) Ranges (50, 100, 200, 500 ppb)

Point (Nominal)	NO/NOX Conc.	Calibration Tolerance	Converter Efficiency
SPAN 1 (80-90%)	425 ppb	± 3%	96% - 104%
SPAN 3 (10-20%)	60 ppb	± 5%	96% - 104%
ZERO		± 1 ppb	

If any of the points are greater than the calibration tolerance for the full-scale range, the calibration is unacceptable. If the calibration is unacceptable after two (2) attempts, contact ECB. All points on the calibration must meet their respective calibration tolerance. Adjustments to the T200UP should be based on ***NOT*** meeting the tolerance criteria. If the calibration is acceptable, enable channels on the Data Logger and logout.

1. Using AV-Trend Software Enable the NOXCAL channel on the Data Logger
   - Press <ESC> <ESC> to return to Home Menu
   - Select "C" (Configuration Menu) <Enter>
   - Select "D" (Configure Data Channels) <Enter>
   - Select "E" (Enable/Mark Channel Online) <Enter>
   - Select "NO", "NO2", and "NOX" <Enter>
   - Confirm that all channels are Enabled by selecting "D" then "F"
   - Press <ESC> twice to return to home menu
   - Select "O" to logout
2. Verify the analyzer is in "Sample" mode and the Calibrator is in "Standby" mode.

2.17.2.2.2 Calibration Check

The purpose of a calibration is to correlate the output of a monitoring system with known traceable concentrations of NO-NO2-NOX. A **calibration check** is to periodically verify that the monitor's calibration has not drifted out of optimal range. The EPA refers to calibration checks as "One Point QC Checks" (Reference 40 CFR Part 58 Appendix A Section 3.2.1) and requires that a **calibration check be performed at least once every 14-days**. As part of a calibration check, perform a precision check and two (2) titration checks. **Refer to Sections 2.17.2.1.3 – 2.17.2.1.5** for Operational Checks that need to be completed *prior* to starting a calibration check. No checks should be made between 6:00 AM and 9:00 AM local time when the potential for ambient exceedances exist.

Copy the 80-90% FS Calibration "CALB" NO, NO2, and NOX values and the 10-20% FS Calibration "CALA" NO, NO2, and NOX values from the most recent calibration into the NO2 elog *(Calibration GPT Tab)* for the calibration check comparison.

If desired, a graph of the minute data during a calibration can be created to track the stabilization of each value. Instructions on how to graph the minute data in AV-Trend are located in Appendix B.

1. Using AV-Trend Software Disable the NOXCAL channel on the Data Logger
   - Press <ESC> <ESC> to return to Home Menu
   - Select "C" (Configuration Menu) <Enter>
   - Select "D" (Configure Data Channels) <Enter>
   - Select "M" (Disable/Mark Channel Offline) <Enter>
   - Arrow down to Select "NO"
   - Repeat for "NO2" and "NOX" <Enter>
   - Press <ESC> twice to return to home menu

A. SPAN ZERO Calibration Check
   1. From the Home Menu on the site computer using the data logger in AV-Trend:
      - Initiate SPAN ZERO using "C", "C", "1" command

- Select “NOXCAL” <Enter>
- Select “SPAN ZERO” <Enter>
- Select “Phase Duration” (Set to 1h) <Enter>
- Select “Start Single Cal (Now)” <Enter>
- Press <ESC> twice to return to home menu

2. View the minute data on the data logger:
   - Select “D” (Real Time Display Menu) <Enter>
   - Select “C” (Continuous Average Report) <Enter>
   - Select “Show Channels 3” <Enter>
   - Type in parameters “NO, NO2, NOX” (“TMP” is optional) <Enter>
   - Start Continuous Report (Minute averages will be displayed on screen)
   - Allow instrument to stabilize until NOX STB < 0.100 ppb, ~15-20 min.
   - Record actual “DIL Flow”, and five stable 1-minute “NO”, “NO2” and “NOX” averages *(elog, 14 Day Check Tab, ZERO).* **NOTE: The measured zero must be ± 1 ppb.**
3. Using the data logger in AV-Trend, abort SPAN ZERO:
   - Press <ESC> as needed to return to main menu
   - Abort SPAN ZERO, using “C”, “C”, “W” command
   - NOXCAL <Enter>

B. SPAN 1 Calibration Check

Adjust the NO flow from the standard NO cylinder to generate a NO concentration of about 80% of the upper range limit (URL) of the NO range. The exact NO concentration is calculated from:

$$[NO]_{ca} = [F_{NO}/(F_{NO} + F_{zero})] * [NO_{std}]$$
$$[NO_2]_{ca} = [F_{NO}/(F_{NO} + F_{zero})] *[NO_{std}]$$

Where: $FN_O + F_{zero}$ = pre-programmed air and gas flows in SCCM
$[NO_{std}]$ = Certified NO gas concentration

Convert: Liters to SCCM by multiplying LPM * 1000
PPB to PPM by multiplying * 1000

1. From the Home Menu on the site computer using the data logger in AV-Trend:
   - Select “C” (Configuration Menu) <Enter>
   - Select “C” (Configure Calibrations) <Enter>
   - Select “1” (Start Singe Phase Calibration) <Enter>
   - Select “NOXCAL” <Enter>
   - Select “SPAN 1” <Enter>
   - Select “Phase Duration” (Set to 8h) <Enter>
   - Select “Start Single Cal (Now)” <Enter>
2. To view the minute data on the data logger:
   - Press <ESC> twice to return to home menu
   - Select “D” (Real Time Display Menu) <Enter>
   - Select “C” (Continuous Average Report) <Enter>
   - Select “Show Channels 3” <Enter>
   - Type in parameters “NO, NO2, NOX” (“TMP” is optional) <Enter>

- Start Continuous Report (Minute averages will be displayed on screen)
- Allow instrument to stabilize until NOX STB < 0.100 ppb, ~20-30 min.
- Enter "CAL Pressure" while SPAN 1 is running *(elog, Logbook Tab).*
- Record actual "CAL Flow", "DIL Flow", and five stable 1-minute "NO", "NO2" and "NOX" averages *(elog, 14 Day Check, SPAN 1 Tab).*

C. Titration/Calibration Check

The following procedure uses the converter efficiency (gas phase titration) to check the NO2 channel. The two GPT points should be located at the 80-90% (B-CAL) of full scale and 10-20% (A-CAL) of full scale in the order given.

1. GPTPS 80-90% Full Scale - On the T700U Panel
   - Press "GEN"
   - Press "GPTPS" – Using the "<TST or TST>" button, *Set* "NO" concentration = 425 ppb <Enter>
   - Using the "<TST or TST>" button, *Set* the "O3" concentration = 405 ppb<Enter>
   - Using the "<TST or TST>" button, *Set* the "TOTAL FLOW" = 3.000 LPM <ENTR>
   - Keep the T700U in GPTPS mode until the "ACT" value for O3 is within 1 ppb of the target value entered (Active LED not flashing + 5 minutes, ~10 min)
2. GPT 80-90% Full Scale - On the T700U Panel
   - Press "GEN"
   - Press "GPT" - Using the "<TST or TST>" button, *Check:* "NO" concentration = 425 ppb, "O3" concentration = 405 ppb, and "TOTAL FLOW" = 3.000 LPM, press <ENTR> for each
   - Allow instrument to stabilize until NOX STB < 0.200 ppb ~20-30 min.
   - Record actual "CAL Flow", "DIL Flow", and five stable 1-minute "NO", "NO2", "NOX" averages *(elog, 14 Day GPT Check Tab, Cal Check GPT 80-90% FS Titration)*. (NOTE: O3 Value on instrument panel will not be displayed during this procedure) **NOTE: The Cal Check 80-90%GPT Full Scale Titration"NO2" should be within 8% of the 80-90% Full Scale Calibration CALB "NO2" value.**
3. GPTPS 10-20% Full Scale - On the T700U Panel
   - Press "GEN"
   - Press "GPTPS" – Using the "<TST or TST>" button, *Set:* "NO" concentration = 70 ppb<Enter>
   - Using the "<TST or TST>" button, *Set* the "O3" concentration = 50 ppb <Enter>
   - Using the "<TST or TST>" button, *Set* the "TOTAL FLOW" = 7.000 LPM <Enter>
   - Keep the T700U in GPTPS mode until the "ACT" value for O3 is within 1 ppb of the target value entered (Active LED not flashing + 5 minutes, ~10 min)
4. GPT 10-20% Full Scale - On the T700U Panel
   - Press "GEN"
   - Press "GPT" - Using the "<TST or TST>" button, *Check:* "NO" concentration = 70 ppb, "O3" concentration = 50 ppb, and "TOTAL FLOW" = 7.000 LPM, press <ENTR> for each.
   - Allow instrument to stabilize until NOX STB < 0.100 ppb, ~20-30 min.
   - Record actual "CAL Flow", "DIL Flow", and five stable 1-minute "NO", "NO2", "NOX" averages *(elog, 14 Day GPT Check Tab, Cal Check 10-20% FS Titration)*. (NOTE: O3 Value on instrument panel will not be displayed during this procedure) **NOTE: The Cal Check 10-20%**

Full Scale Titration "NO2" should be within 10% of the 10-20% Full Scale Calibration "NO2" value.

B. Calibrator Purge Procedure

To activate the PURGE feature – On the T700U Panel

3. Press "GEN"
4. Press "PURGE"

The calibrator should be purged until the NOX STB on the T200UP panel <0.100 ppb, ~10 min.
When the purge is complete: Abort SPAN 1

- Abort SPAN 1, using "C", "C", "W" command
- NOXCAL <Enter>

E. Check SPAN 3 – make no adjustments

- Press <ESC> twice to return to the home menu
- Initiate SPAN 3 using "C", "C", "1" command
- Select "NOXCAL" <Enter>
- Select "SPAN 3" <Enter>
- Select "Phase Duration" (Set to 1h) <Enter>
- Select "Start Single Cal (Now)" <Enter>

View the minute data

- Select "D" (Display Real-Time) <Enter>
- Select "C" (Continuous Average Report) <Enter>
- Select "Show Channels 3" <Enter>
- Type in parameters "NO", "NO2", and "NOX" ("TMP" is optional) <Enter>
- Press <ESC> twice to return to home menu
- Allow instrument to stabilize until NOX STB < 0.100 ppb, ~20-30 min.
- Record actual "CAL Flow", "DIL FLOW", and five stable 1-minute "NO", "NO2" and "NOX" averages *(elog, 14 Day Check Tab, SPAN 3)*.
- Abort SPAN 3, using "C", "C", "W" command
- NOXCAL <Enter>

Review the NO-NO2-NOX Calibration Check point results. Acceptance Criteria for each Calibration Check Point are:

Point (Nominal)	NO/NOX Conc.	Calibration Tolerance
SPAN 1 (80-90%)	425 ppb	± 10%
SPAN 3 (10-20%)	60 ppb	± 10%
ZERO		±1 ppb

If any of the points are outside the calibration check tolerance for the full-scale range, the calibration check is unacceptable. If the calibration check is unacceptable after two (2) tries, contact ECB and/or conduct the required manual calibration.

NOTE: The SPAN 3 NO ppb and NOX ppb gas concentrations (cells N20 and cell P20 on the 14 Day Check Tab) and the 10-20% level NO2 gas concentration (cell L24 on the 14 Day GPT Check Tab) are reported to AQS as AQ98 values.

F. Change T200UP Filter and Perform Leak Check (Section 2.17.2.2.4)

The NO-NO2-NOX channels should be enabled after the completion of the calibration check.

Using AV-Trend Software Enable the NOXCAL channel on the Data Logger

1. Press <ESC> <ESC> to return to Home Menu
   - Select “C” (Configuration Menu) <Enter>
   - Select “D” (Configure Data Channels) <Enter>
   - Select “E” (Enable/Mark Channel Online) <Enter>
   - Select “NO”, “NO2”, and “NOX” <Enter>
   - Press <ESC> twice to return to home menu
   - Confirm that all channels are Enabled by selecting “D” then “F”
   - Select “O” to logout
2. Verify the analyzer is in “Sample” mode and the Calibrator is in “Standby” mode.

2.17.2.2.3 Filter Change and Leak Check Procedure

The particulate filter should be changed every 14 days or less. When filter (PN 002730000) is changed handle it and the wetted surfaces of the filter housing as little as possible. Teledyne API recommends using gloves or tweezers to avoid contamination of the sample filter. To change the filter, the T200UP should be in the "SAMPLE" mode:

2.17.2.2.3.1 Filter Change

1. Disconnect the exhaust port line from the instrument rear panel (see **Appendix A, Figure 1**).
2. Open the T200UP’s hinged front panel and unscrew the hold down ring on the filter assembly (see **Appendix A, Figure 2 and Figure 3**)
3. Carefully remove the hold down ring, glass window, nitrile O-ring, PTFE O-ring with notches, and filter element.
4. Replace the filter, being careful that the element is fully seated and centered in the bottom of the holder.
5. Reinstall the PTFE O-ring with the notches up and aligned with the hole, nitrile O-ring, the glass window; screw on the hold down ring, hand tighten. Inspect the seal between the edge of filter and the PTFE O-ring to assure a proper seal.
6. Re-connect the exhaust port line to the instrument. Record date of filter change *(elog, Logbook Tab).* The filter does not require conditioning.

2.17.2.2.3.2 Leak Check Procedure

1. Remove the top cover and cap the O3 dryer vent (see **Appendix A, Figure 4**).
2. Remove the sample line and cap the sample port (see **Appendix A, Figure 2**). Cap must be wrench tight.
3. After several minutes, note the “RCEL” pressure and the “SAMP” pressure using the “<TST” or “TST>” keys on the T200UP. If both readings are within 0.2 in-Hg-A of each other, the pump is in good condition.
4. Remove the caps and reconnect the sample line, replace the cover
5. Record leak check pass/fail (Y/N) *(elog, Logbook Tab).*

2.17.2.2.4. Data Retrieval

Each month, the CO statistician initiates a data review by providing a raw data report (in a spreadsheet format) to each Regional Office. (Reference Section III: Regional Office Polling and Data Review and Section IV: Data

Review & Validation QA Plan for Continuous Gaseous & Non-Speciated Particulate Monitors) The CO may request the Regional Office to send additional data that are needed beyond what the CO requires for verifying any missing data supplied by the Regional Office. These data can be retrieve from the "site computer" as needed

2.17.2.3 File Management

Field operators must have a PC (or lap top) to generate the elog files from a Microsoft Excel template file. The NO-NO2-NOX "Logbook", "Calibration" and "Cal Check" elog sheets are provided by the Central Office and updated periodically. The file naming protocol is provided below. ***A formalized file naming convention has been established through consensus of the regions and the Central Office and should be used by all regions.***

2.17.2.3.1 Opening, Naming and Storing the Site Files

Field operators must have a PC (or lap top) to generate the elog files from a Microsoft Excel template file. The elog template file used at the site should be stored on the PC used for field operations by the field technician. Elogs can also be found in IBEAM or on the Ambient network drives. The NO-NO2-NOX "Logbook", "Calibration" and "Cal Check" elog sheets are provided by the Central Office and updated periodically.

1. Open the appropriate elog workbook template file using Excel
2. Left click the "file" toolbar icon, scroll down to "save as" and left click. Every time a new elog if filled out using the template, it must be renamed and saved as a separate and complete workbook (all sheets, i.e., tabs saved) to preserve the record. ***Do not copy over previously completed elogs.***
3. Under file name (highlighted) change workbook file name using the following format: Site ID NO-NO2-NOX Date Activity. For example, "TO NO2 20160829 BF.xls" is a Calibration Check at Triple Oak on August 29, 2016.
4. Change save location to operator's choice of folders
5. Left click "save"
6. Find the tab needed for the task involved. The first tab selected should be the Logbook. Fill in information as indicated.
7. Open other tabs as needed and fill in information as indicated.
8. Save the workbook (elog) periodically and when finished entering data.

2.17.2.3.2 Data Handling and Validation

All site files generated in the field will be stored on a dedicated server in the Regional Office. These files should be transferred to the Official File on a frequent and regular schedule as established by the Region. This is necessary to prevent the potential loss of such files from the field computer and to maintain a "paper trail" for providing defensible data. This also makes the data easily and readily available for review by the Regional Chemist and transfer to the P: drive for review by the Central Office. The files on the site/operator PC can be copied and transferred to the common hard drive and/or be transferred as attachments in email for storage in the official folder.

The site files should be transferred every two weeks and backed up on a monthly basis. This serves as a backup system in the event the official PC fails or is removed or the site files are damaged. These files will be retained for a minimum of five years. When the need arises to review a file for data validation or site operations the official folder is used or a hardcopy is created from this file. For details on data validation procedures, please reference Section III (SOP 2.8.3): Regional Office Polling and Data Review and Section IV (SOP 2.41.4): Data Review and Validation QA Plan for Continuous Gaseous and Non-Speciated Particulate Monitors.

2.17.2.3.3 Monthly Data Summary Validation

Monthly data summaries are provided to the Regional Offices (ROs) by the CO in an electronic format using Microsoft Excel. At the end of the descriptive file name provided to the RO will be the number _1(e.g. Descriptive File Name_1.xls). The RO must open this file, rename by changing the number _1 to _2 and then save the file. After the RO has reviewed and edited the data, the edited file (_2) is resaved to the shared p: drive. This edited file is reviewed by the CO, edited further if needed after consultation with the RO and then saved after renaming the file using a _3. The fully edited file data are then uploaded into AQS by the CO.

The validation checks that will be done are:

1. Providing proper null codes indicating calibrations, audits, etc.
2. Providing missing valid data
3. Documenting any invalid data as to reason with proper null code
4. Identifying any data that may be associated with exceptional events

In some cases, "valid" data that are judged to be out of the ordinary are retained and an information flag is added in AQS by the CO. An example would be high concentration values resulting from an exceptional event. EPA has recently begun applying stricter standards for what it will accept as an exceptional event. In any case where the Region wishes for data to be considered "exceptional," the Region should gather sufficient documentation to support the claim in accordance with a policy memorandum from the CO dated June 29, 2007. Usually high concentration values that may be the result of an exception event must be noted as such on the AQS monthly data summary reports, but not deleted. Any exceptional event will be flagged in AQS by the Central Office using the appropriate qualifier code.

A list of Null Codes that are routinely used during data validation on the AQS monthly summary report are listed below. (Partial List).

Commonly Used EPA-AQS Null Value Codes (partial list)

AE	Shelter Temperature outside Limits
AN	Machine or Equipment Malfunction
AS	Poor Quality Assurance Results
AT	Calibration (by ECB Lab)
AV	Power Failure
AZ	QC (ECB Lab)
BA	Maintenance and Routine Repairs (including filter changes)
BC	Multi-point Calibration
BD	Auto Calibration
BF	Precision/Zero/Span
BJ	Operator Error
BK	Site Computer/Data Logger Down

2.17.2.4 Revision/History

1. Updated Revision Number and formatting
2. Modified Section 2.17.2 for easier comprehension, combining procedures and activities common to Calibration and Calibration Checks into Section 2.17.2.1.3 – 2.17.2.1.5.
3. Moved diagrams of Model T700U calibrator display screens to Appendix A and B.

4. Moved detailed procedure for Filter Change and Leak Check to newly created Appendix C
5. Corrected mistakes in revision version as noted by Operators.
6. Frequency of Calibration changed from 180 to 365 days
7. Changed acceptance criteria for SPAN 1
8. Increased dilution flow during 10-20% Titrations FROM 3.000 LPM to 7.000 LPM
9. Removed Site Call Section and Remote Calibration Procedure
10. Added location on elogs to input data
11. Added Data Retrieval Section to include current procedures
12. Modified File Management plan to include current procedures
13. Added commonly used EPA and AQS null void codes to Section 2.17.2.3.1
14. Added Calibration Flow Chart with T700U Display Settings (Appendix A)
15. Added Calibration Check Flow Chart with T700U Display Settings (Appendix B)
16. Added Appendix D with instructions on how to graph minute data in AV-Trend
17. Removed Monitor Shutdown Procedure
18. Added Revision/History Section

Appendix A: Calibration Flow Chart and T700U Display Screen

1. Check site integrity
2. Verify instruments and equipment operating properly
3. Disable/Mark Channels Offline
4. Change the Particulate Filter and perform a leak check
5. Reset Convertor Efficiency A and B
6. Start SPAN ZERO (1 hr duration)
    a. Allow the analyzer to stabilize (NOX STB <0.100 ppb, ~15 min)
    b. Reset the ZERO Set Point (Press ZERO, wait for stability, press <ENTR>)
    c. Record data *(elog, Calibration Tab, ZERO)*
    d. Abort SPAN ZERO **NOTE: The measured zero must be ± 1 ppb.**
7. Start SPAN 1 (8 hr duration)
    a. Allow the analyzer to stabilize (NOX STB <0.100 ppb, ~15-20 min)
    b. Set NOX concentration to 425 and NO concentration to 425
    c. Press SPAN, wait for stability, press <ENTR> (NOX STB <0.100 ppb, ~15-20 min)
    d. Record data *(elog, Calibration Tab, SPAN 1)* **NOTE: The measured zero must be ± 3% of the expected value.**
8. Start Titration/Calibration

GPTZ 80-90% Full Scale:

a. Press "GEN" and *Set* "GPTZ" values: NO=425, NOX=405, Total Flow 3 LPM, press <ENTR> for each
a. Allow the analyzer to stabilize (NOX STB <0.200 ppb, ~20-30 min)
b. Record data *(elog, Calibration GPT Tab, 80-90% FS GPTZ Titration "CALB" along with GPTZ settings Entered and T700U Display GPTZ values).*

GPTPS 80-90% Full Scale: (no values will be recorded)

a. Press "GEN" and *check* "GPTPS" values: NO=425, NOX=405, Total Flow 3 LPM
b. Wait until "ACT" value for O3 is within 1 ppb of target (LED not flashing + 5 minutes, ~10 min)

GPT 80-90% Full Scale:

a. Press "GEN" and *check* "GPT" values: NO=425, NOX=405, Total Flow 3 LPM, press <ENTR> for each.
b. Allow the analyzer to stabilize (NOX STB <0.200 ppb, ~20-30 min)
c. Record data *(elog, Calibration GPT Tab, 80-90% FS GPTPS/GPT, "CALB")*
d. Press "CONC", "CONV", "NO2B", then edit and enter the "NO2B (O3)" concentration which is calculated (see elog, Calibration GPT Tab, Cell J20)
e. Press "CALB" to calibrate the "B" point
f. Press "CAL" <Enter> <Exit> <SetB>
g. Record "SETB Gain" Converter Efficiency value from the front panel display *(elog, Calibration GPT Tab, After Adj. Converter Efficiency Box)*
h. Press <Exit><Exit><Exit> to leave the Converter Efficiency menu.

GPTZ 10-20% Full Scale:

a. Press "GEN" and *Set* "GPTZ" values: NO=70, NOX=50, Total Flow 7 LPM, press <ENTR> for each
b. Allow the analyzer to stabilize (NOX STB <0.100 ppb, ~20-30 min)
c. Record data *(elog, Calibration GPT Tab, 10-20% FS GPTZ Titration "CALA" along with GPTZ settings Entered and T700U Display GPTZ values).*

GPTPS 10-20% Full Scale: (no values will be recorded)

a. Press "GEN" and *check* "GPTPS" values: NO=70, NOX=50, Total Flow 7 LPM
b. Wait until "ACT" value for O3 is within 1 ppb of target (LED not flashing + 5 minutes, ~10 min)

GPT 10-20% Full Scale:

a. Press "GEN" and *check* "GPT" values: NO=70, NOX=50, Total Flow 7 LPM
b. Allow the analyzer to stabilize (NOX STB <0.100 ppb, ~15-20 min)
c. Record data *(elog, Calibratin GPT Tab, 10-20% FS GPTPS/GPT, "CALA")*

GPT 10-20% Full Scale NO2 Calibration:

a. Press "CONC", "CONV", "NO2A", then edit and enter the "NO2A (O3)" concentration which is calculated (**see elog, Cal GPT Tab, Cell J36**)
b. Press "CALA" to calibrate the "A" point
c. Press "CAL" <Enter> <Exit> <SetA>
d. Record "SETA Gain" Converter Efficiency value from the front panel display *(elog, Calibration GPT Tab, After Adj. Converter Efficiency Box)*
e. Press <Exit><Exit><Exit> to leave the Converter Efficiency menu.
f. Allow the analyzer to stabilize (NOX STB <0.100 ppb, ~20-30 min)
g. Record data *(*elog, Calibration GPT, 10-20% FS Calibration "CALA")

GPTPS 80-90% Check:

a. Press "GEN" and *Set* "GPTPS" values: NO=425, NOX=405, Total Flow 3 LPM, press <ENTR> for each.
b. Wait for "ACT" value for O3 is within 1 ppb of target (LED not flashing + 5 minutes, ~10 min)

GPTPS 80-90% Check:

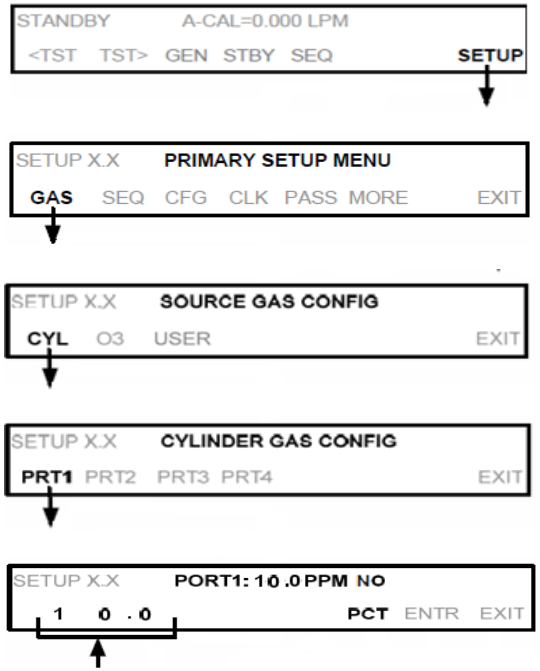
a. Press "GEN" and *check* GPT values: NO=425, NOX=405, Total Flow 3 LPM, press <ENTR> for each.
b. Allow the analyzer to stabilize (NOX STB <0.200 ppb, ~20-30 min)
c. Record data *(elog, Calibration GPT Tab, 80-90% FS Calibration "CALB")* ***These values will be used during each 14-day 80-90% Full Scale Calibration Check until a new calibration is completed.***

Purge

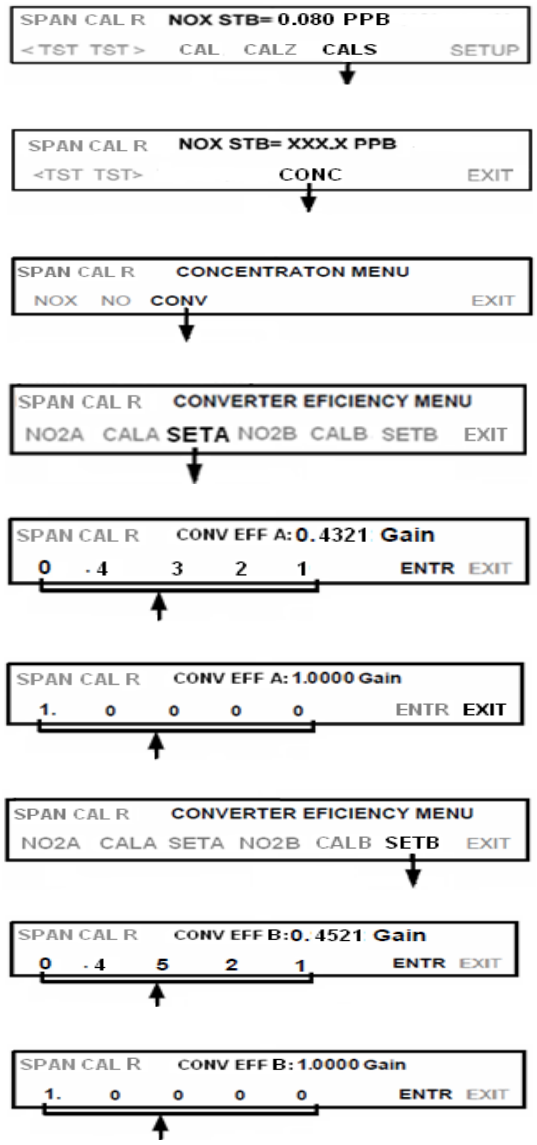
a. Press "GEN" then "PURGE"
b. Allow instrument to stabilize (NOX STB <0.100 ppb, ~10 min)
c. Abort SPAN 1

9. Check SPAN 3 – make no adjustments
    a. Start SPAN 3 (1 hr duration)
    b. Allow the analyzer to stabilize (NOX STB <0.100 ppb, ~15-20 min)
    c. Record data *(elog, Calibration Tab, SPAN 3)* **NOTE: The measured "NO" and "NOX" span should be ± 5% of the expected value.**
    d. Abort SPAN 3
10. Review Calibration tolerance for acceptable values
11. Enable/Mark Channels Online – Analyzer on Sample – Calibrator on Standby

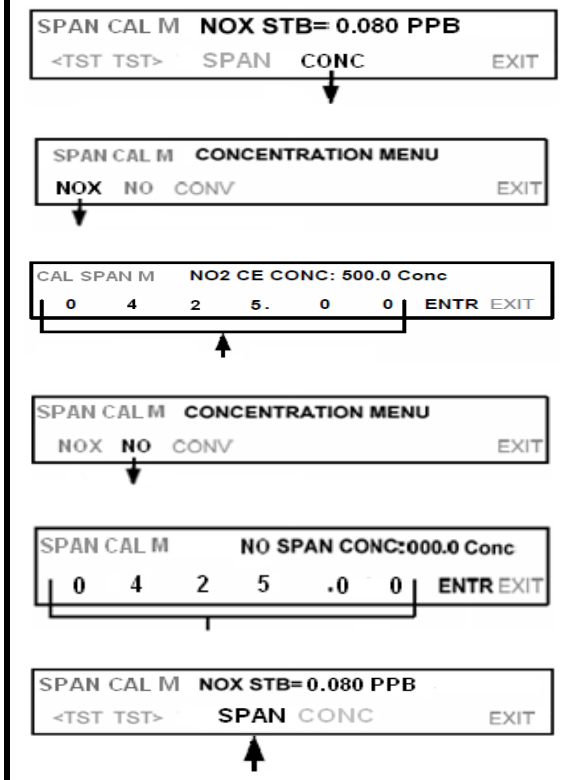
Gas Cylinder and Calibrator Check:



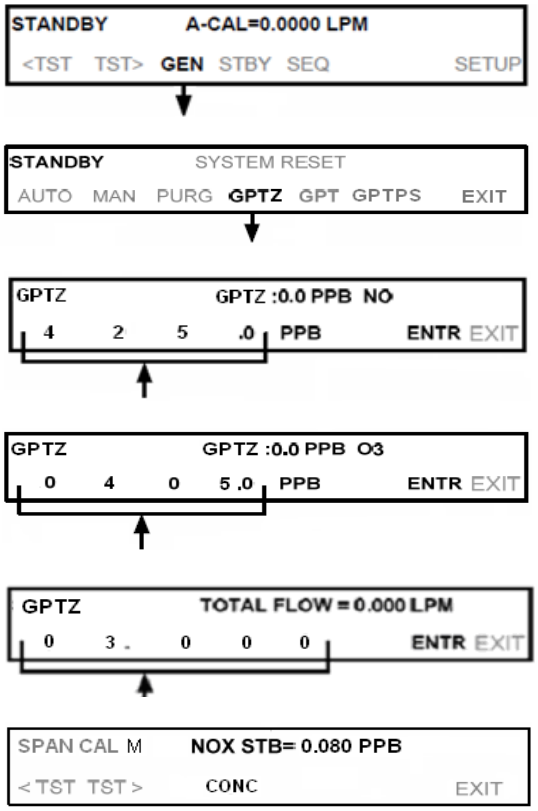
Reset Converter Efficiency A and B:



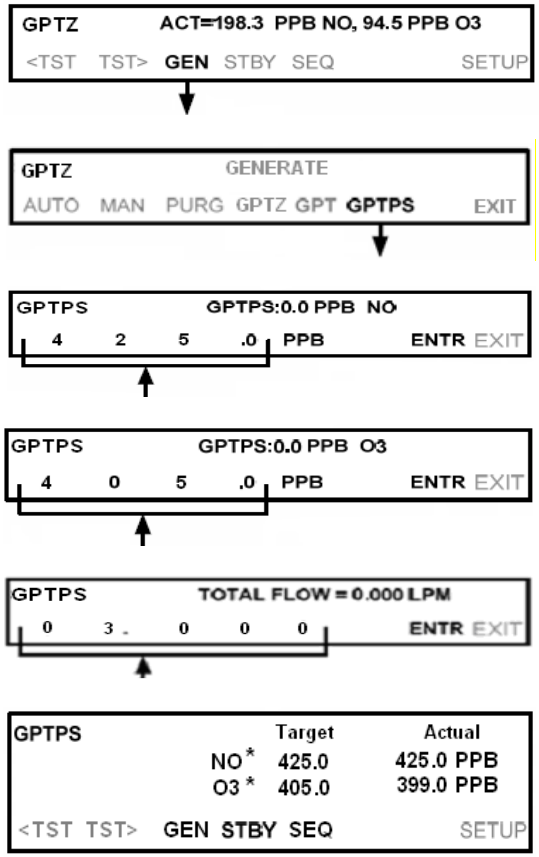
SPAN 1:



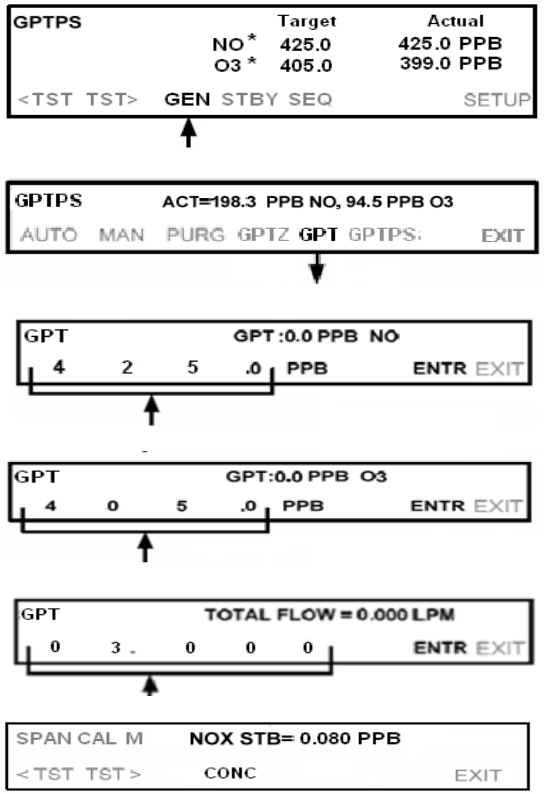
GPTZ 80-90% Full Scale:



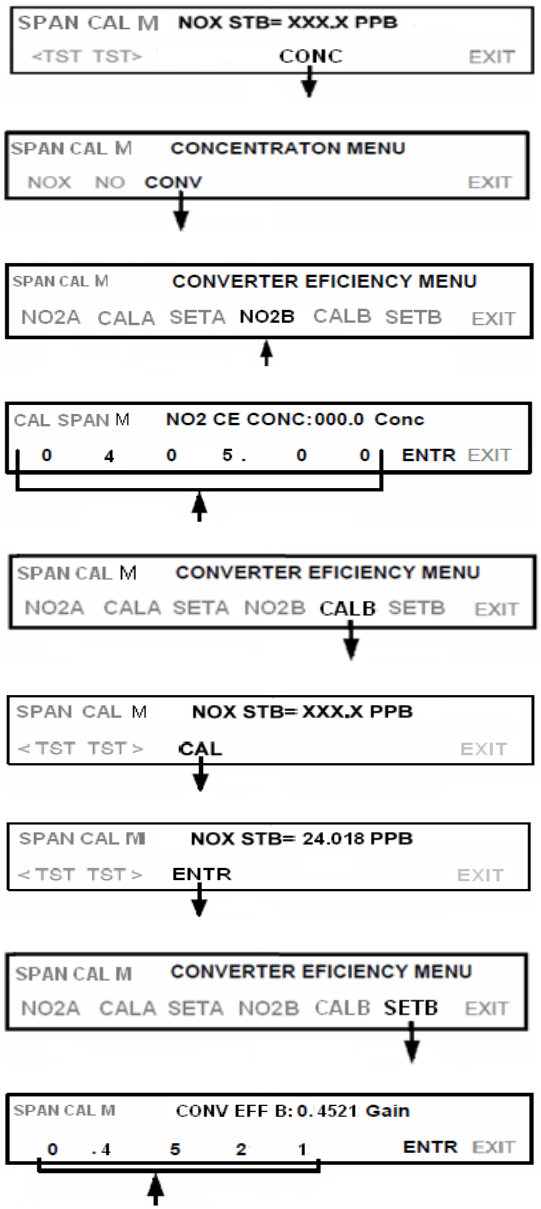
GPTPS 80-90% Full Scale:



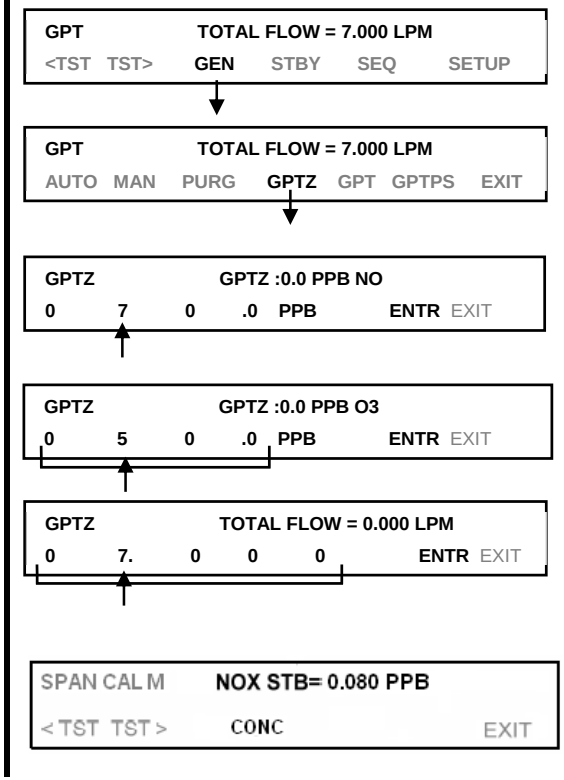
GPT 80-90% Full Scale:



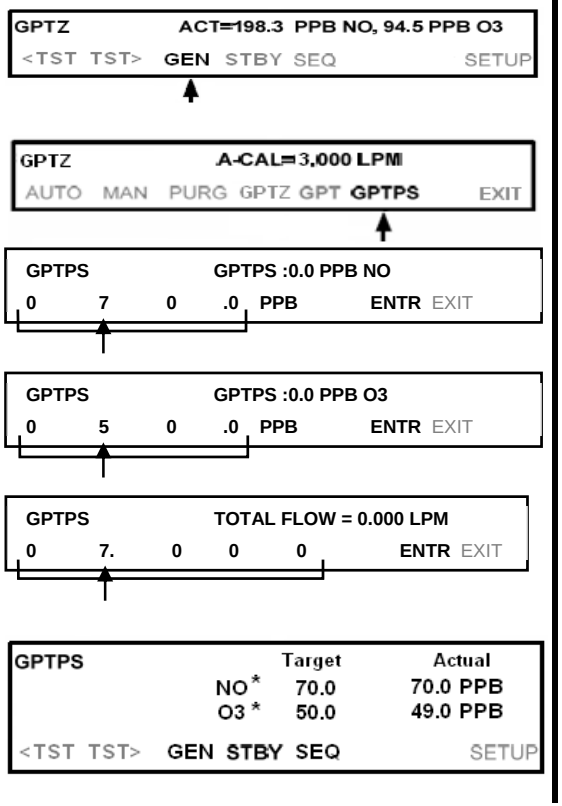
GPT 80-90% Full Scale NO2 Calibration:



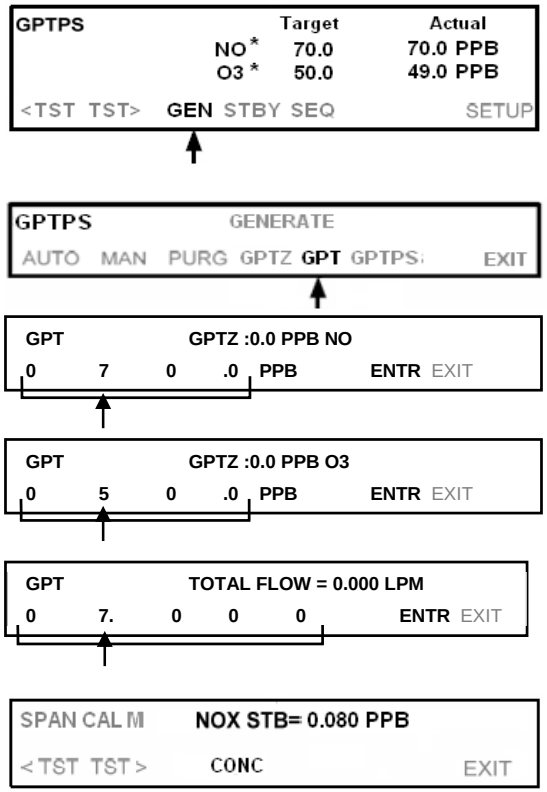
GPTZ 10-20% Full Scale:



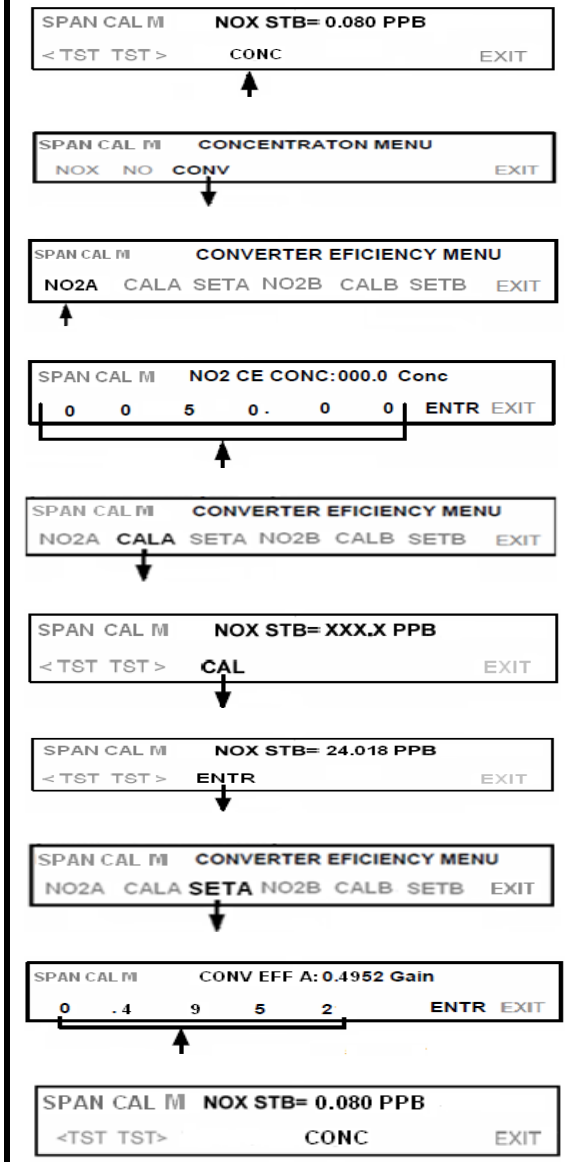
GPTPS 10-20% Full Scale:



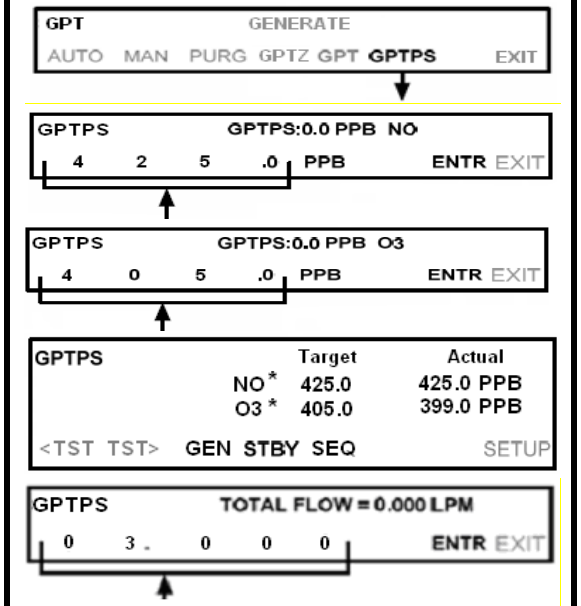
GPT 10-20% Full Scale:



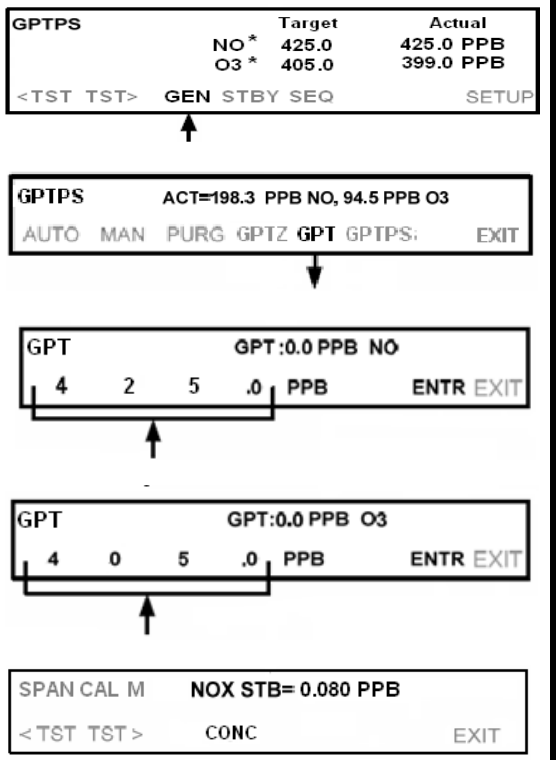
10-20% Calibration:



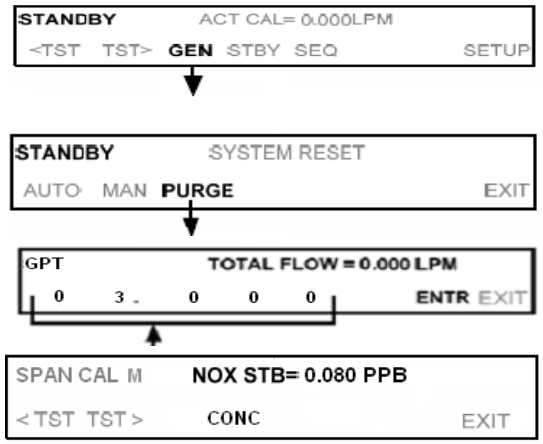
80-90%% Full Scale Check:



GPT 80-90% Full Scale:



Purge:



Appendix B: Calibration Check Flow Chart and T700U Display Screen

1. Check site integrity
2. Verify instruments and equipment operating properly
3. Disable/Mark Channels Offline
4. Start SPAN ZERO Calibration Check (1 hr duration)
    a. Allow the analyzer to stabilize (NOX STB <0.100 ppb, ~15 min)
    b. Change the Offset/Slope, based on the zero-point measurement
    c. Record data *(elog, 14 Day Check Tab, ZERO)*
    d. Abort SPAN ZERO
5. Start SPAN 1 Calibration Check (8 hr duration)
    a. Allow the analyzer to stabilize (NOX STB <0.100 ppb, ~20-30 min)
    b. Record data *(elog, 14 Day Check Tab, SPAN 1)*
6. Start Titration/Calibration Check

   GPTPS 80-90% Full Scale: (no values will be recorded)

    a. Press "GEN" and set "GPTPS" values: NO=425, NOX=405, Total Flow 3 LPM, press <ENTR> for each
    b. Wait for "ACT" value for O3 is within 1 ppb of target (LED not flashing + 5 minutes, ~10 min)

   GPT 80-90% Full Scale:

    a. Press "GEN" and check "GPT" values: NO=425, NOX=405, Total Flow 3 LPM, press <ENTR> for each
    b. Allow the analyzer to stabilize (NOX STB <0.200 ppb, ~20-30 min)
    c. Record data *(elog, 14 Day GPT Check Tab, Cal Check GPT 80-90% FS Titration)*

   GPTZ 10-20% Full Scale: (no values will be recorded)

    a. Press "GEN" and set "GPTPS" values: NO=70, NOX=50, Total Flow 7 LPM, press <ENTR> for each
    b. Wait for "ACT" value for O3 is within 1 ppb of target (LED not flashing + 5 minutes, ~10 min)

   GPT 10-20% Full Scale:

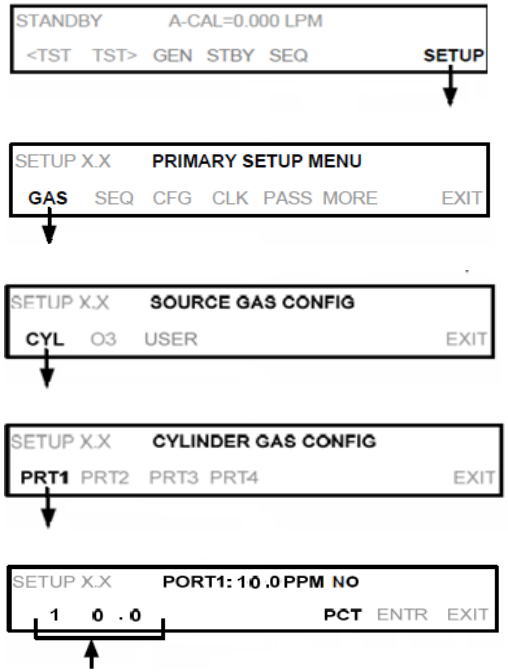
    a. Press "GEN" and check "GPT" values: NO=70, NOX=50, Total Flow 7 LPM, press <ENTR> for each
    b. Allow the analyzer to stabilize (NOX STB <0.100 ppb, ~20-30 min)
    c. Record data *(elog, 14 Day Check Tab, Cal Check GPT 10-20% FS Titration)*

   Purge

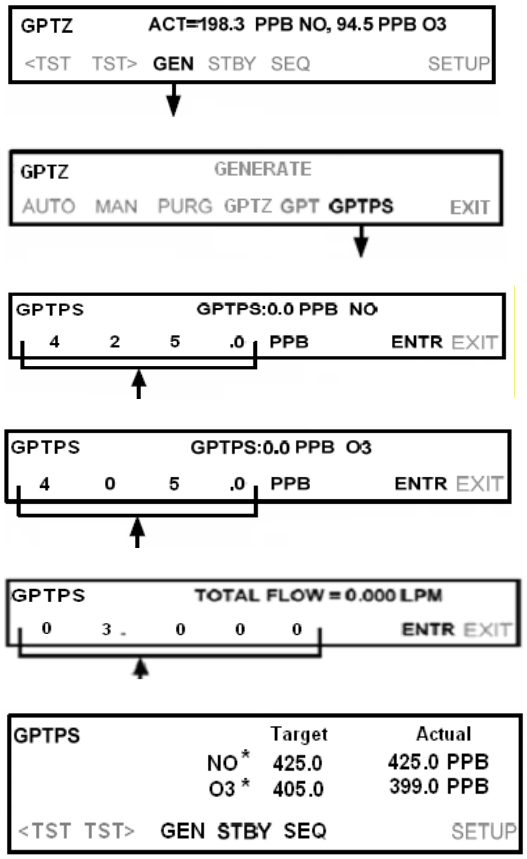
    a. Press "GEN" then "PURGE"
    b. Allow instrument to stabilize (NOX STB <0.100 ppb, ~10 min)
    c. Abort SPAN 1

7. Check SPAN 3 – make no adjustments
    a. Start SPAN 3 (1 hr duration)
    b. Allow the analyzer to stabilize (NOX STB <0.100 ppb, ~20-30 min)
    c. Record data *(elog, 14 Day Check Tab, SPAN 3)*
    d. Abort SPAN 3
8. Review Calibration Check data for acceptable values
9. Change the Particulate Filter and perform a leak check
10. Enable/Mark Channels Online – Analyzer on Sample – Calibrator on Standby

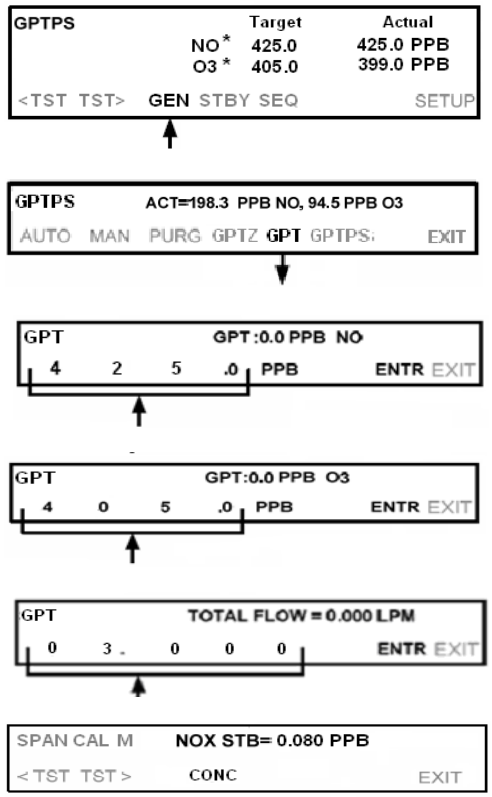
Gas Cylinder and Calibrator Check:



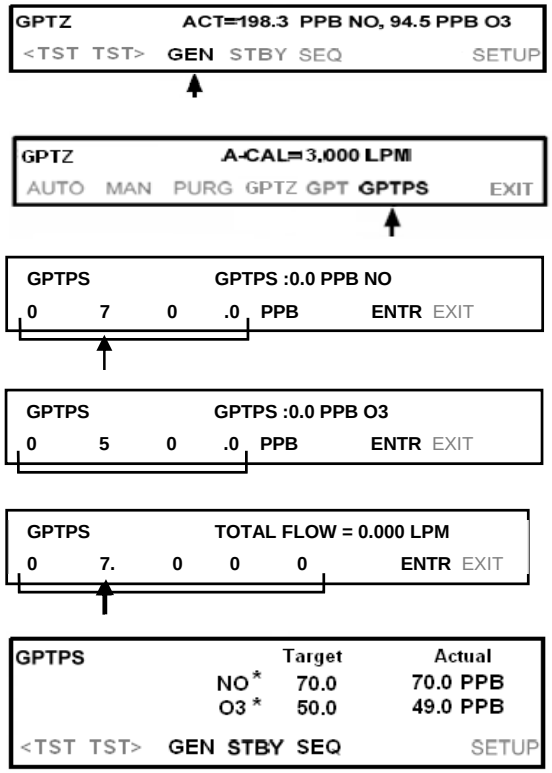
GPTPS 80-90% Full Scale:



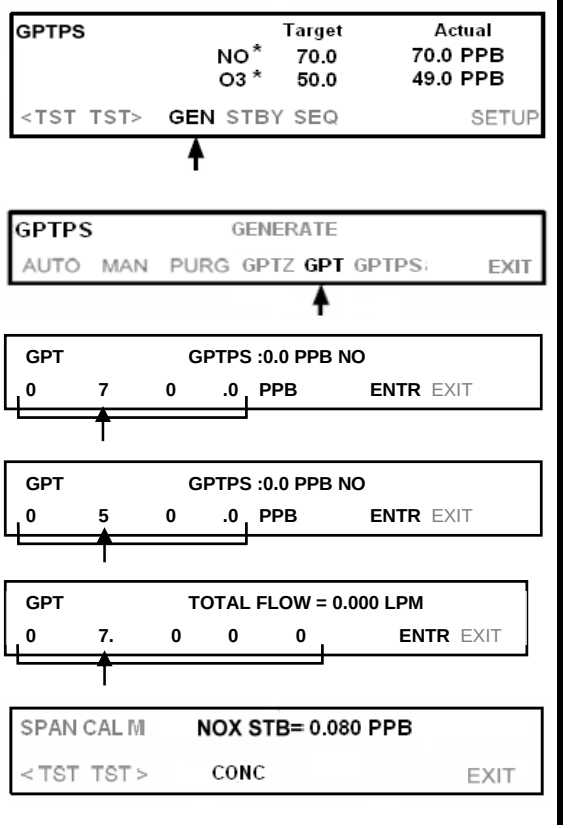
GPT 80-90% Full Scale:



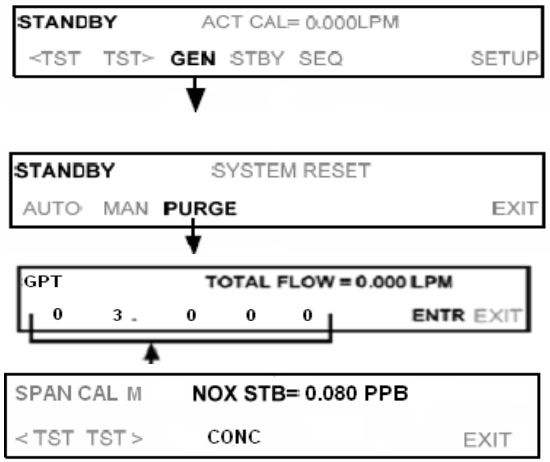
GPTPS 10-20% Full Scale:



GPT 10-20% Full Scale:



Purge:



Appendix C: Filter Change and Leak Check Procedure

Filter Change

The particulate filter should be change every 14 days or less. When filter (PN 002730000) is changed handle it and the wetted surfaces of the filter housing as little as possible. Teledyne API recommends using gloves or tweezers to avoid contamination of the sample filter. To change the filter, the T200UP should be in the "SAMPLE" mode:

1. Remove the exhaust port line from the instrument rear panel (see **Figure 1**).

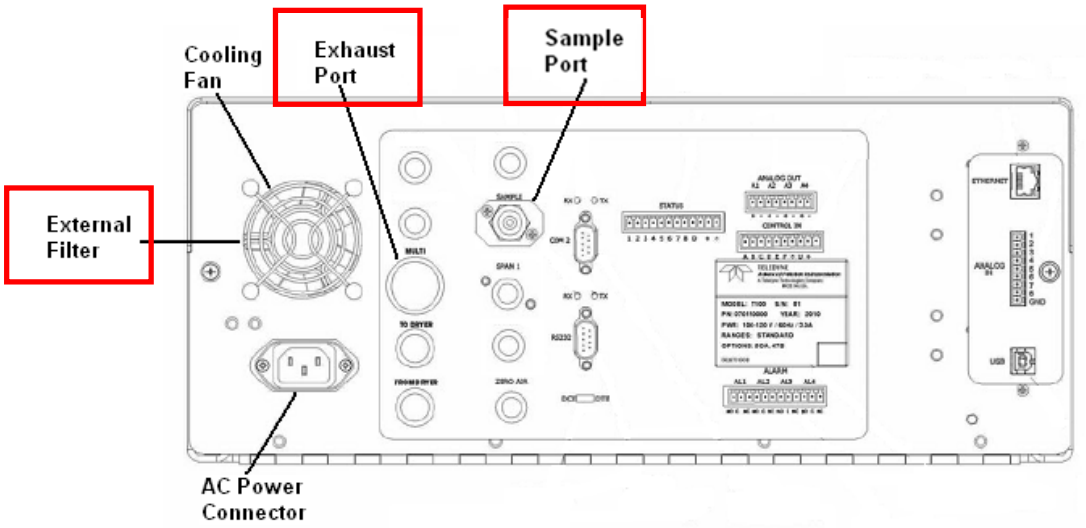


Figure 1 T200UP Rear Panel

2. Open the T200UP's hinged front panel and unscrew the hold down ring on the filter assembly (see **Figure 2** and **Figure 3**).

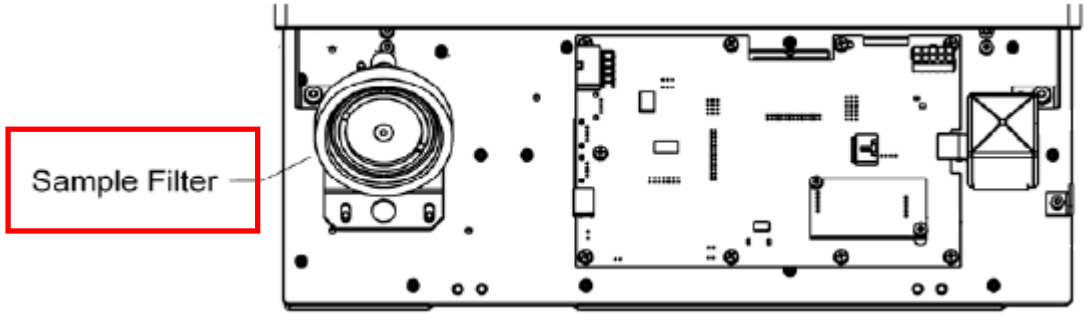


Figure 2 T200UP Hinged Front Panel

3. Carefully remove the hold down ring, glass filter cover, O-ring, PTFE O-ring, and filter element.

4. Replace the filter, being careful that the element is fully seated and centered in the bottom of the holder.

5. Reinstall the PTFE O-ring with the notches up and aligned with the hole. Inspect the seal between the edge of filter and the PTFE O-ring to assure a proper seal. Next install the O-ring, the glass cover, and then screw on the hold down ring, hand tighten.

6. Re-install the exhaust port line to the instrument. The filter does not require conditioning.

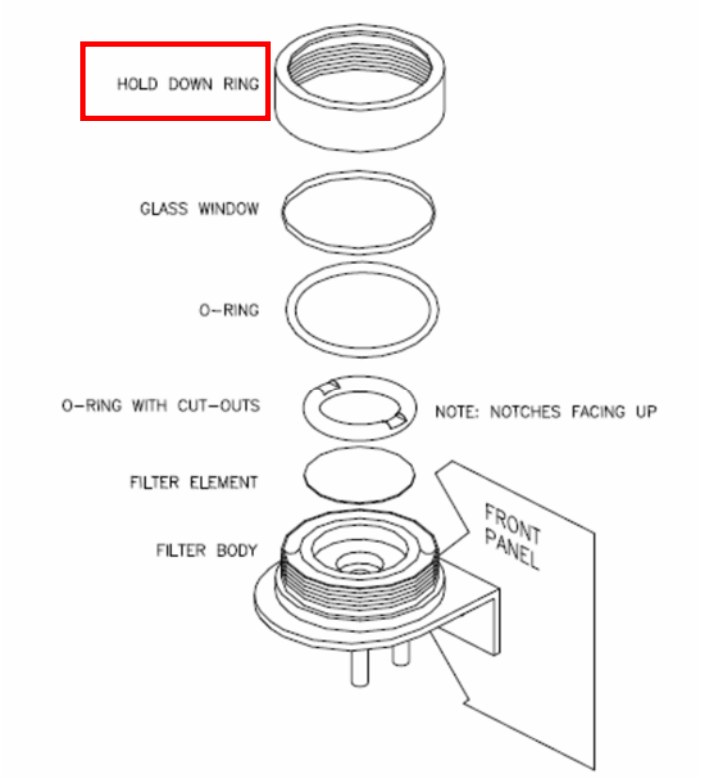


Figure 3 T200UP Particulate Filter Assembly

Leak Check Procedure

6. Remove the top cover and cap the O3 dryer vent (see Figure 4).
7. Remove the sample line and cap the sample port (see Figure 2). Cap must be wrench tight.
8. After several minutes, note the "RCEL" pressure and the "SAMP" pressure using the "<TST" or "TST>" keys on the T200UP. If both readings are within 0.2 in-Hg-A, the pump is in good condition.
9. Remove the caps and reconnect the sample line, replace the cover
10. Record leak check pass/fail (Y/N) *(elog, Logbook Tab)*

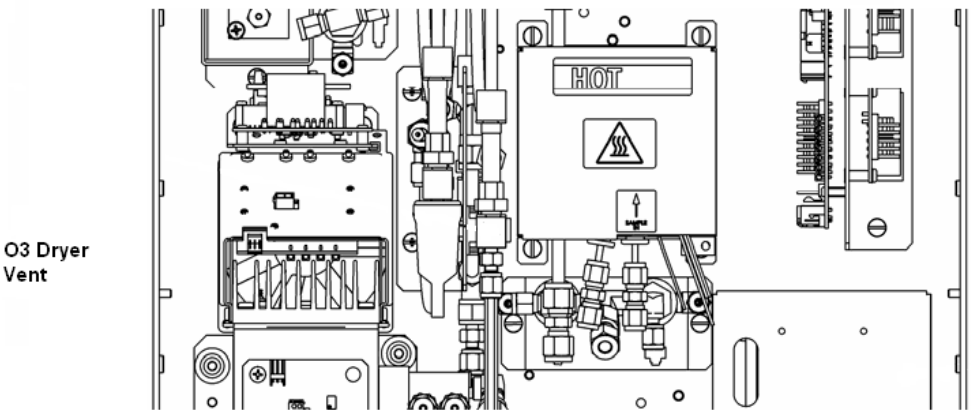
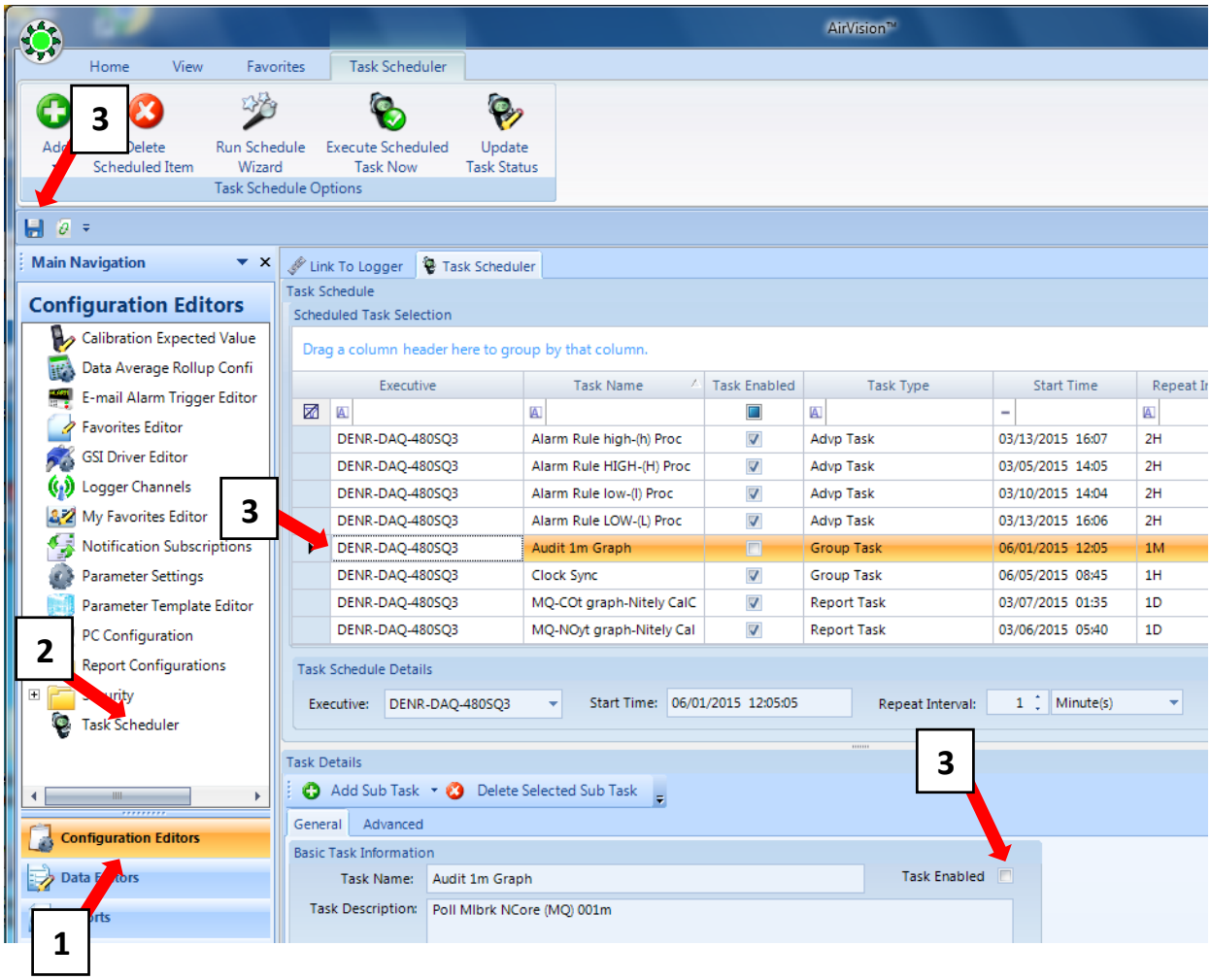


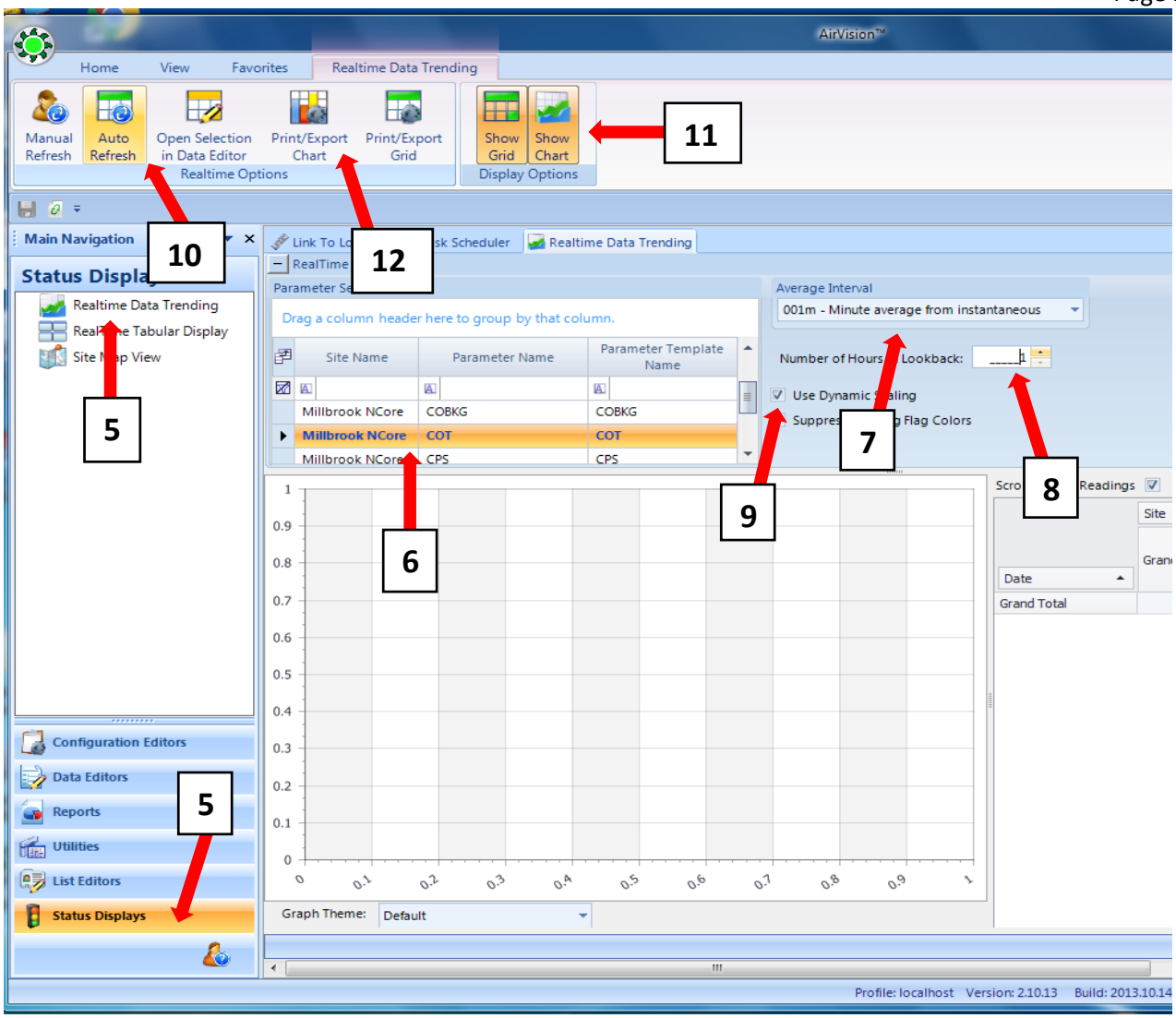
Figure 4 O3 Dryer Vent

Appendix D: Real Time Minute Data Graphing in AV-Trend

1. Link to the data logger in AV-Trend.
2. In the **Configuration Editors** menu, select **Task Scheduler.**
3. There may be more than one task already created within the Task Scheduler, but each site should already have a task created to poll minute data. The ECB has set up a task, called 'Graphing Poll' on AV-Trend to be activated when needed. The task should not be enabled during normal operation. If the check box under the **Task Enabled** column is not checked, click on the task and then press the save button (the floppy disk at the top of the screen). The details of the task will appear in the bottom half of the AV-Trend screen.



4. Using the data logger window, navigate through your procedure as normal to start an event (calibration, calibration check, etc.).
5. Select **Status Displays** in the bottom of the left hand column, and then select **Real-time Data Trending**.



6. In the **Real-time Data Trending** window, select the site parameter(s) that is to be monitored.
7. In the drop down menu for **Average Interval**, select 001m – Minute average from instantaneous.
8. In the setting for **Number of Hours in Lookback**, select 1. This is the option for how far back the graph will be plotted.
9. Ensure that **Dynamic Scaling** is checked.
10. Select **Auto Refresh** from the top of the screen. This will automatically update the graph with minute data.
11. If the **Show Grid** and **Show Chart** buttons are selected at the top of the screen, data will begin populating the window.
12. Select **Print/Export Chart** to save the graph. In the top right corner are two PDF options. Select the first PDF option to save onto the CPU, removable data, or in any other desired destination.
13. When graphing the minute data is complete, disable the 'Graphing Poll' task in the **Task Scheduler** screen by highlighting the task unchecking the Task Enable box below. **Make sure to press the save button (floppy disk icon at the top of the screen) to complete disabling the task.**

INSTRUCTIONS (NO2 E-LOG)

General

1> **Fill in the WHITE boxes →** [ ] *The White boxes are for operator entered parameters.*

2> All cells except "White" are locked [WHITE]

3> **Back-up your records** after every site visit. From your laptop to a flashdrive, cd, the network, whatever is most reliable for you or your region. **Let your Regional Ambient Monitoring Coordinator know your method of back-up.**

4> Prepare a new e-log for each visit and save with: Logger ID, pollutant, date, and code.
(e. g. MG NO2 YYYYMMDD BF)

Codes:

AN	MACHINE MALFUNCTION
BC	MULTI-POINT CALIBRATION
BF	PRECISION/ZERO/SPAN

5> Regional Ambient Monitoring Coordinator Initials [ ] Date [ ]

Comments:

LOGBOOK (NO2 E-LOG)

Site: | Date: | Time: | Operator:

Routine Site Inspection

Building Power On (Y/N)
Building Secure (Y/N)
Sample Line OK/Heated (Y/N)
Funnel in Place (Y/N)
Screen in Place (Y/N)
Building Temp.°C — Sensor | NIST | OK (± 2 ºC)

Teledyne 701 Zero Air

Serial No.
Date Installed
Expiration Date
Delivery Pressure (psig)
Days Remaining: 0

Teledyne Model T200UP NO-NO2-NOx Analyzer

Serial No.
INST. RANGE / UNITS 500 ppb (Y/N)
RCELL TEMP (40 ± 0.1 °C)
BOX TEMP (Amb ± 5°C)
PMT TEMP (5 ± 2°C)
RCEL PRESS (<4 IN-HG-A)
SAMP PRESS (Amb ± 1.0 IN-HG-A)
Alarms? (Y/N)

T700U Calibrator

Serial No.
Exp.Date
Alarms? (Y/N)
CAL PRES (psig)
DIL PRES (psig)
BOX TEMP (Amb ± 5°C)
Days Remaining: 0

Gas Cylinder

Cylinder No.
Cylinder Exp. Date
Cylinder NO Conc.
Cylinder Press (psig)
Days Remaining: 0

T200UP Filter Change / Leak Check

Date Particulate Filter changed
Leak Check within 0.2 in-Hg-A (Y/N)

Data logger / Computer

	Date	Time
Computer :		
PDL :		

Data Logger
Primary Data Logger OK? (Y/N)

T200UP Pre-Calibration Checks **Calibration Factors:**

	Nox Slope (0.700 to 1.300)	Nox OFFS (-20.0 to 150.0)	NO Slope (0.700 to 1.300)	NO OFFS (-20.0 to 150.0)		SETA CE Gain	SETB CE Gain
Pre-Calibration					**Pre Calibration**		
Post Calibration					**Post Calibration**	0.0000	0.0000

Comments/Notes:

Calibration (NO2 E-LOG)

Site: 0 Date: 1/0/00 Time: 0:00 Operator: 0

Cylinder NO Conc: 0.00

Span	Flow Rate (sccm)	Flow Rate (sccm)	T700U	T700U	T700U
	(CAL)	(DIL)	NO ppb	NO2 ppb	NOx ppb
0			#DIV/0!	#DIV/0!	#DIV/0!
1			#DIV/0!	#DIV/0!	#DIV/0!
3			#DIV/0!	#DIV/0!	#DIV/0!

ZERO	Data Logger		
Hrs:min	NO ppb	NO2 ppb	NOx ppb
Avg ppb	#DIV/0!	#DIV/0!	#DIV/0!
Acceptable:	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**
	diff ± 1 ppb		

SPAN 1	Data Logger		
Hrs:min	NO ppb	NO2 ppb	NOx ppb
Avg ppb	#DIV/0!	#DIV/0!	#DIV/0!
% Diff	**#DIV/0!**		**#DIV/0!**
Acceptable:	**Yes**		**Yes**
	[diff ± 3%]		[diff ± 3%]

SPAN 3	Data Logger		
Hrs:min	NO ppb	NO2 ppb	NOx ppb
Avg ppb	#DIV/0!	#DIV/0!	#DIV/0!
% Diff	**#DIV/0!**		**#DIV/0!**
Acceptable:	**Yes**		**Yes**
	[diff ± 5%]		[diff ± 5%]

Comments/Notes:

Calibration Gas Phase Titration (NO2 E-LOG)

Site: 0 Date: 1/0/00 Time: 0:00 Operator: 0

GPTZ Settings Entered		
NO		ppb
O3		ppb
Ftotal		sccm
T700U DISPLAY GPTZ		
NO		ppb
CAL		sccm
DIL		sccm

80-90% FS GPTZ Titration "CALB"

Data Logger			
Hrs:min	NO ppb	NO2 ppb	NOx ppb
Avg ppb	#DIV/0!	#DIV/0!	#DIV/0!

80-90% FS GPTPS / GPT "CALB"

Data Logger			
Hrs:min	NO ppb	NO2 ppb	NOx ppb
Avg ppb	#DIV/0!	#DIV/0!	#DIV/0!

80-90% FS Calibration "CALB" [1]

Data Logger			
Hrs:min	NO ppb	NO2 ppb	NOx ppb
Avg ppb	#DIV/0!	#DIV/0!	#DIV/0!

GPTZ (NO) #DIV/0! ppb
GPT (NO) #DIV/0! ppb
→ NO2B (O3) #DIV/0! ppb

After Adj. Converter Efficiency
SETB Gain

GPTZ Settings Entered		
NO		ppb
O3		ppb
Ftotal		sccm
T700U DISPLAY GPTZ		
NO		ppb
CAL		sccm
DIL		sccm

10-20% FS GPTZ Titration "CALA"

Data Logger			
Hrs:min	NO ppb	NO2 ppb	NOx ppb
Avg ppb	#DIV/0!	#DIV/0!	#DIV/0!

10-20% FS GPTPS / GPT "CALA"

Data Logger			
Hrs:min	NO ppb	NO2 ppb	NOx ppb
Avg ppb	#DIV/0!	#DIV/0!	#DIV/0!

10-20% FS Calibration "CALA" [2]

Data Logger			
Hrs:min	NO ppb	NO2 ppb	NOx ppb
Avg ppb	#DIV/0!	#DIV/0!	#DIV/0!

GPTZ (NO) #DIV/0! ppb
GPT (NO) #DIV/0! ppb
→ NO2A (O3) #DIV/0! ppb

After Adj. Converter Efficiency
SETA Gain

[1] Values in this table will be used during each future 14-day 80-90% Full Scale Calibration Check until a new calibration is completed

[2] Values in this table will be used during each future 14-day 10-20% Full Scale Calibration Check until a new calibration is completed

Comments/Notes:

14 Day Check (NO2 E-LOG)

Site: 0 Date: 1/0/00 Time: 0:00 Operator: 0

Cylinder NO conc: 0

Span	Flow Rate (sccm)	Flow Rate (sccm)	T700U	T700U	T700U
	(CAL)	(DIL)	NO ppb	NO2 ppb	NOx ppb
0			#DIV/0!	#DIV/0!	#DIV/0!
1			#DIV/0!	#DIV/0!	#DIV/0!
3			#DIV/0!	#DIV/0!	#DIV/0!

ZERO	Data Logger		
Hrs:min	NO ppb	NO2 ppb	NOx ppb
Avg ppb	#DIV/0!	#DIV/0!	#DIV/0!
	diff ± 1ppb		
Acceptable:	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**

SPAN 1	Data Logger		
Hrs:min	NO ppb	NO2 ppb	NOx ppb
Avg ppb	#DIV/0!	#DIV/0!	#DIV/0!
% Diff	**#DIV/0!**		**#DIV/0!**
	[% diff ± 8%]		[% diff ± 8%]
Acceptable:	**#DIV/0!**		**#DIV/0!**

SPAN 3	Data Logger		
Hrs:min	NO ppb	NO2 ppb	NOx ppb
Avg ppb	#DIV/0!	#DIV/0!	#DIV/0!
% Diff	**#DIV/0!**		**#DIV/0!**
	[% diff ± 10%]		[% diff ± 10%]
Acceptable:	**#DIV/0!**		**#DIV/0!**

Comments/Notes:

14 Day Gas Phase Titration (NO2 E-LOG)

Site: 0 Date: 1/0/00 Time: 0:00 Operator: 0

Span	Flow Rate (sccm)	Flow Rate (sccm)
	(CAL)	(DIL)
CALB		

80-90% FS Calibration "CALB"

(copy/paste from latest calibration)

NO ppb	NO2 ppb	NOx ppb
#DIV/0!	#DIV/0!	#DIV/0!

Cal Check GPT 80-90% FS Titration

Hrs:min	NO ppb	NO2 ppb	NOx ppb
Avg ppb	#DIV/0!	#DIV/0!	#DIV/0!
% Diff		**#DIV/0!**	

CALB NO2 Check

[± 8%]

#DIV/0!

Span	Flow Rate (sccm)	Flow Rate (sccm)
	(CAL)	(DIL)
CALA		

10-20% FS Calibration "CALB"

(copy/paste from latest calibration)

NO ppb	NO2 ppb	NOx ppb
#DIV/0!	#DIV/0!	#DIV/0!

Cal Check GPT 10-20% FS Titration

Hrs:min	NO ppb	NO2 ppb	NOx ppb
Avg ppb	#DIV/0!	#DIV/0!	#DIV/0!
% Diff		**#DIV/0!**	

CALA NO2 Check

[± 10%]

#DIV/0!

Comments/Notes: